VOLUME 41 NUMBER 5 MAY, 1956

# AMERICAN JOURNAL OF OPHTHALMOLOGY

THIRD SERIES FOUNDED BY EDWARD JACKSON

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Publication office: 450 Ahnaip St., Menasha, Wisconsin

*Copyright, 1956, Ophthalmic Publishing Company, 664 North Michigan Avenue, Chicago 11, Illinois*

*Subscription price in United States twelve dollars yearly. In Canada and foreign countries fourteen dollars.* Published monthly by the Ophthalmic Publishing Company. Subscription and Advertising Office: 664 North Michigan Avenue, Chicago 11, Illinois. Entered as second class matter at the post office at Menasha, Wisconsin. Printed in U.S.A.

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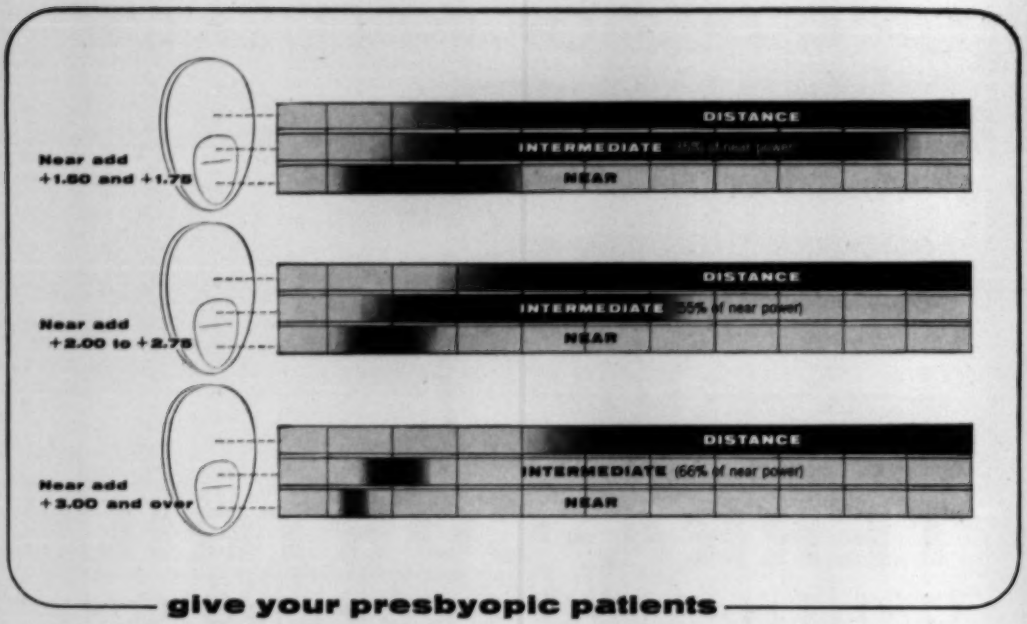


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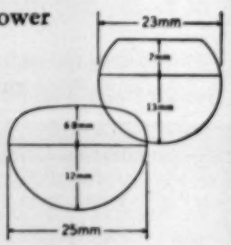


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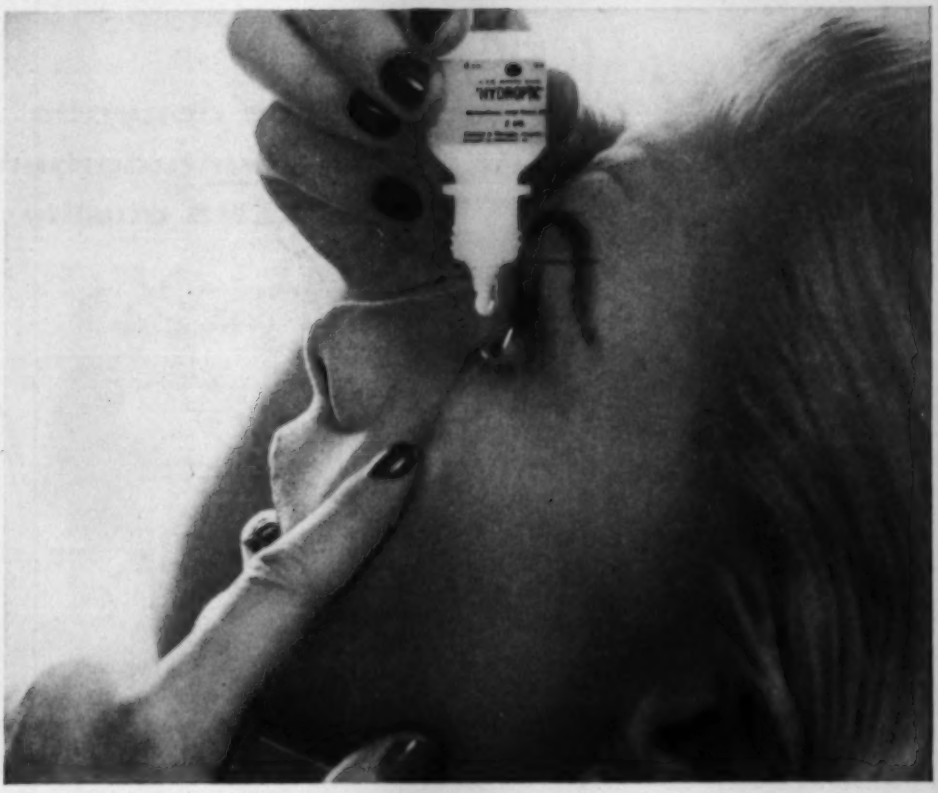


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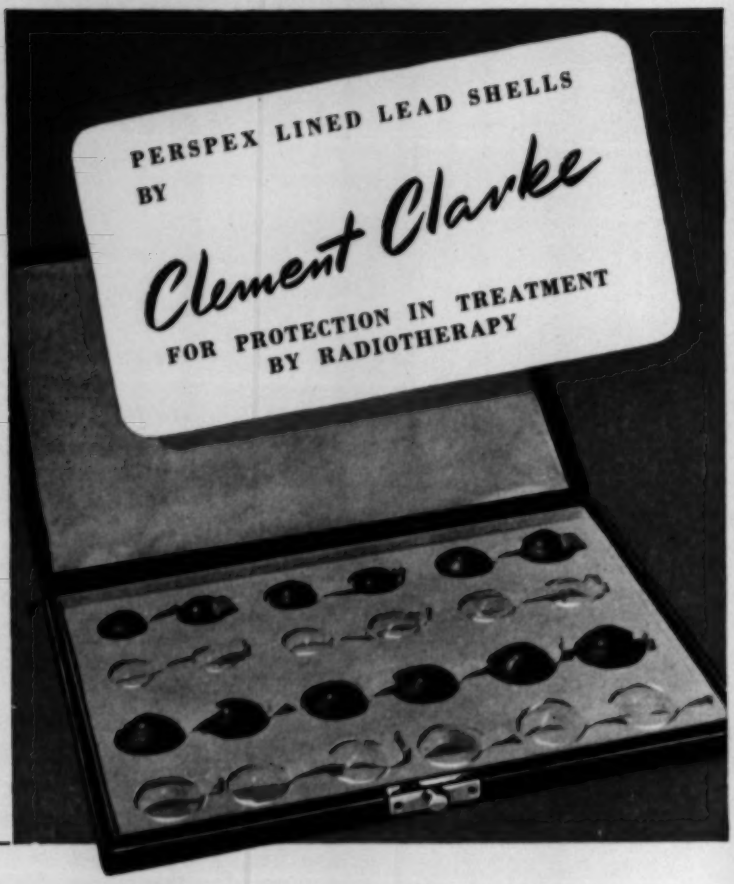

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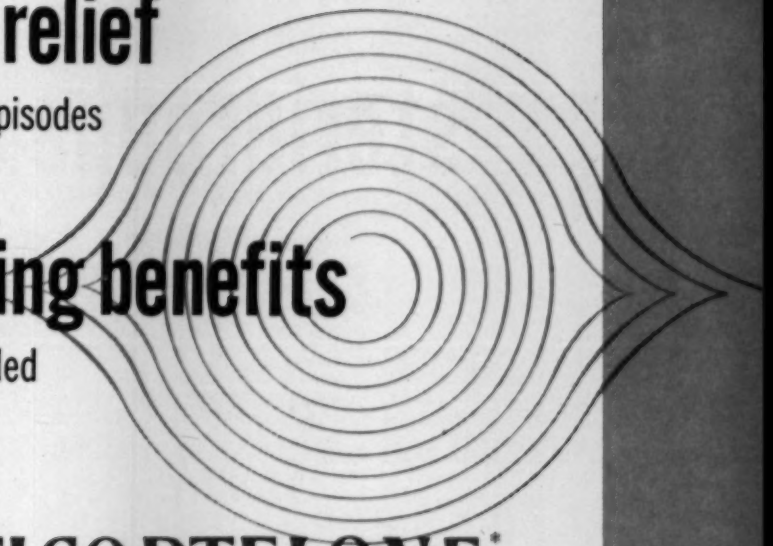

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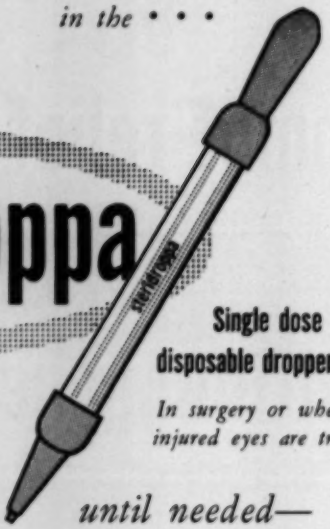


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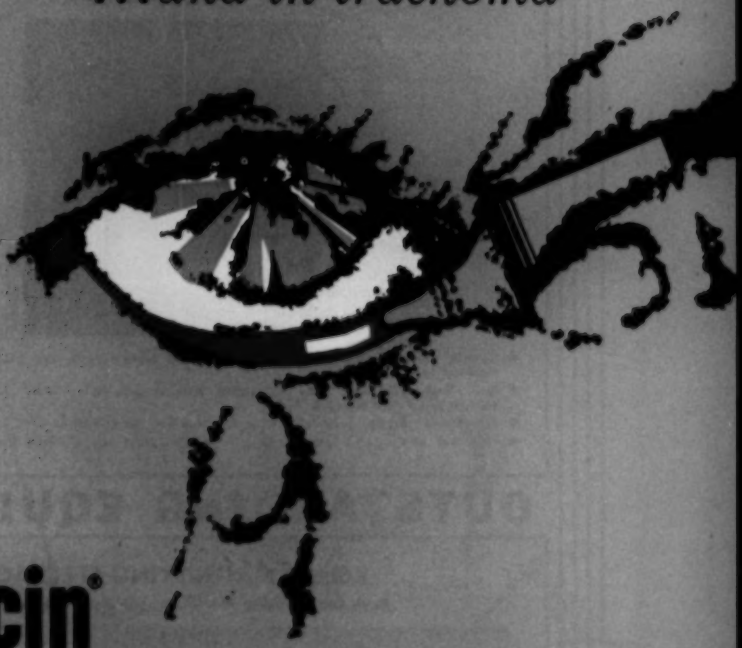

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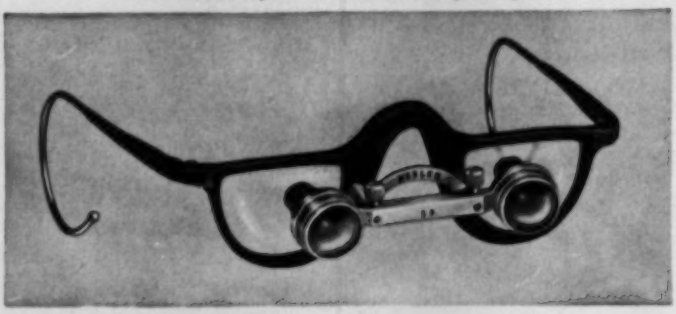

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1. Clark, W. B., Transactions of A.A.O. and O. 7-8, 1952. Copies of this paper are available on request.

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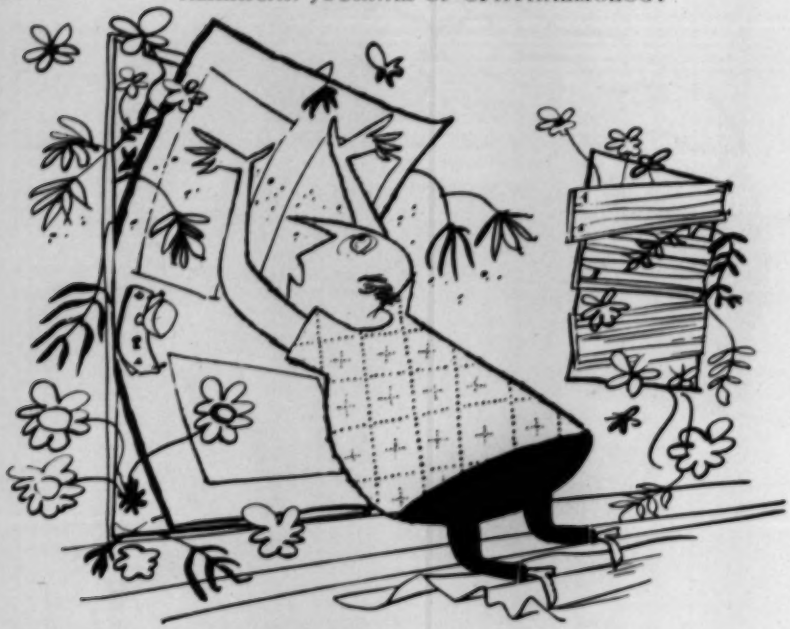

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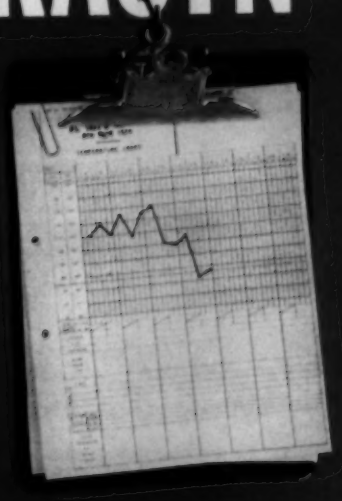

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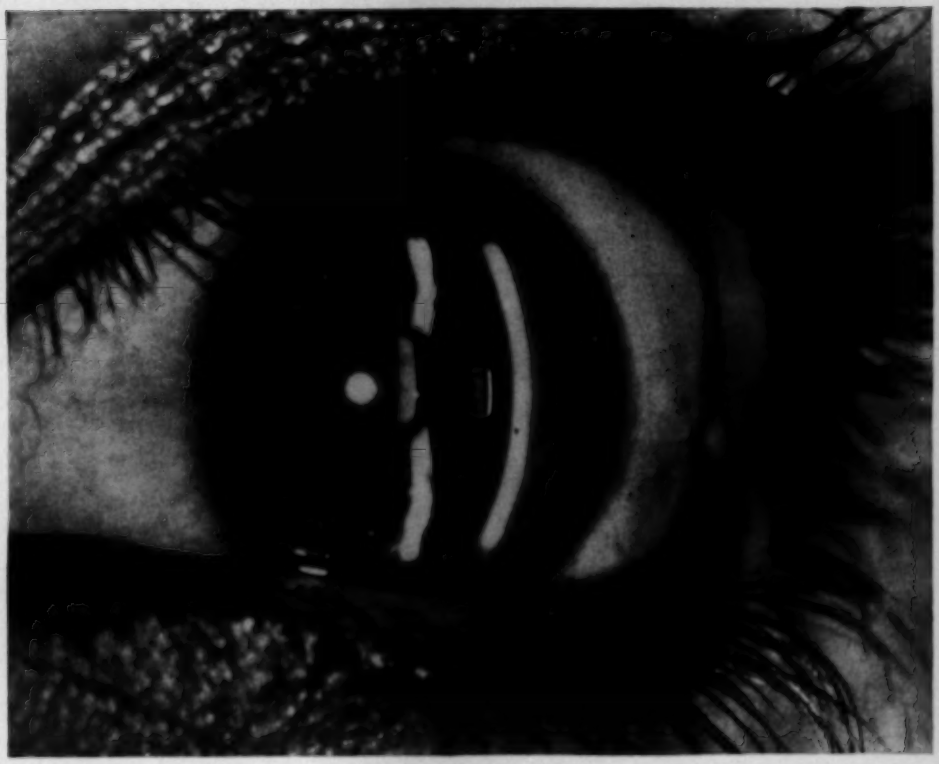

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*References:* 1. Hogan, M. J., Thygeson, P. and Kimuras, J., *Arch. Ophth.* 53:165, Feb. 1955.

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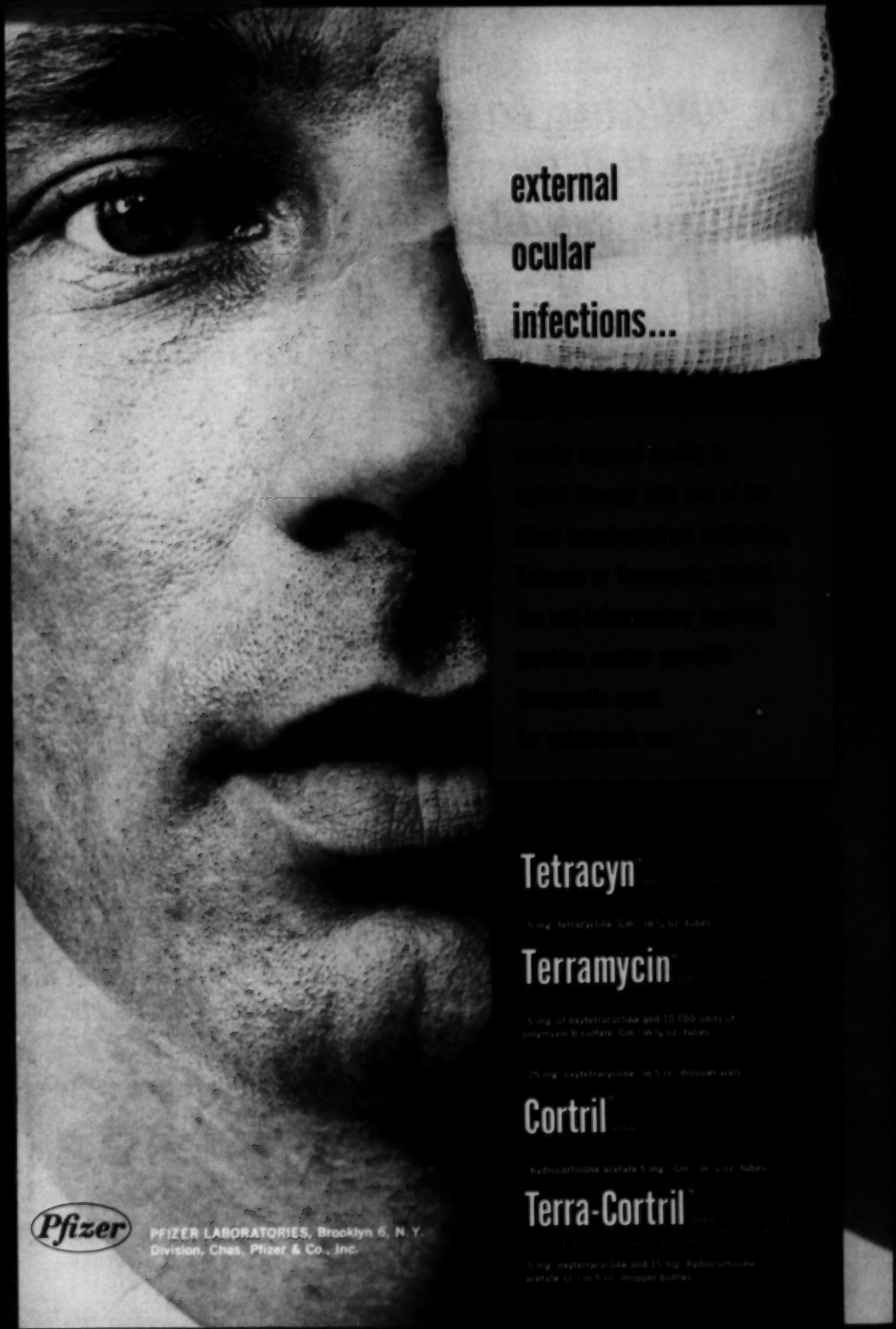
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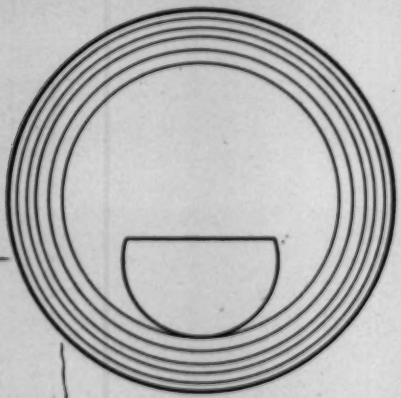

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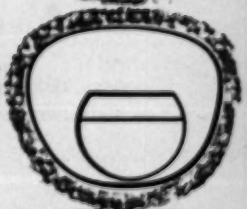

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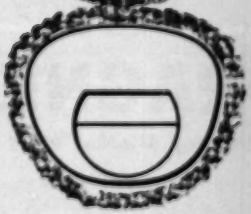

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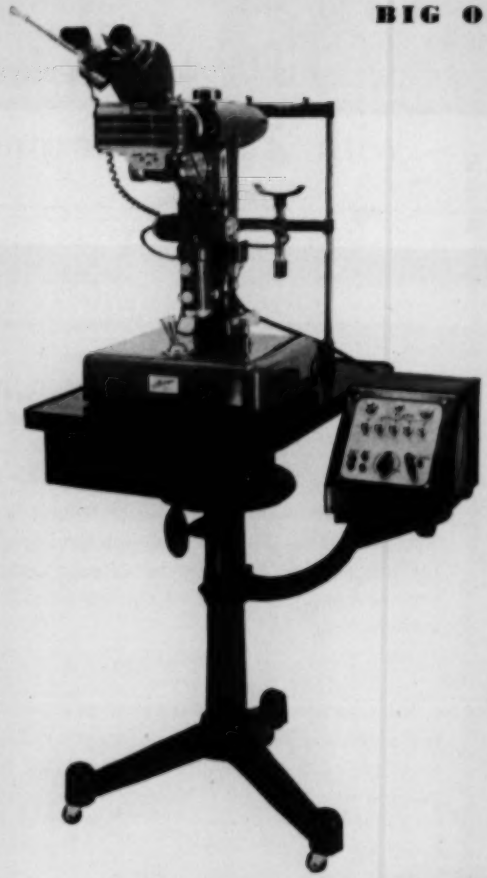

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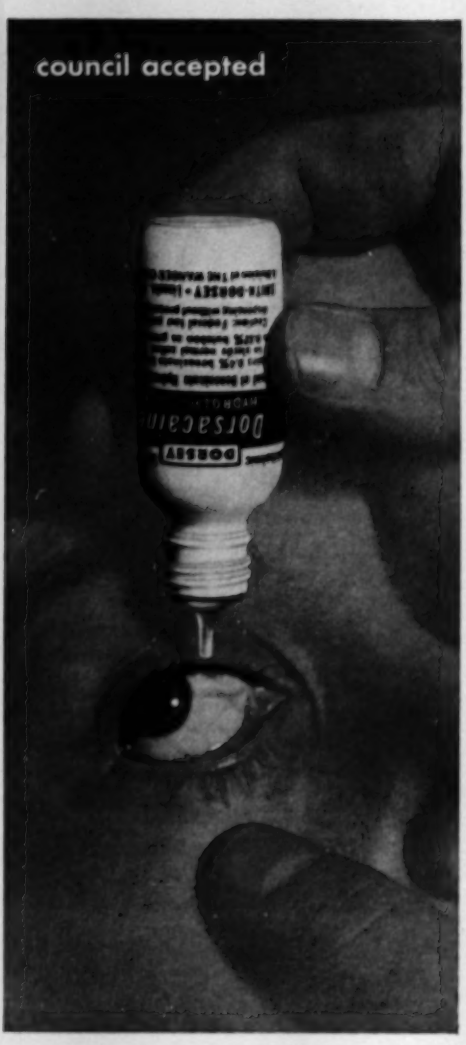

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*Schlegel, H. E., Jr., and Swan, K. C.: A. M. A. Arch. Ophth. *51*:643 (May) 1954.

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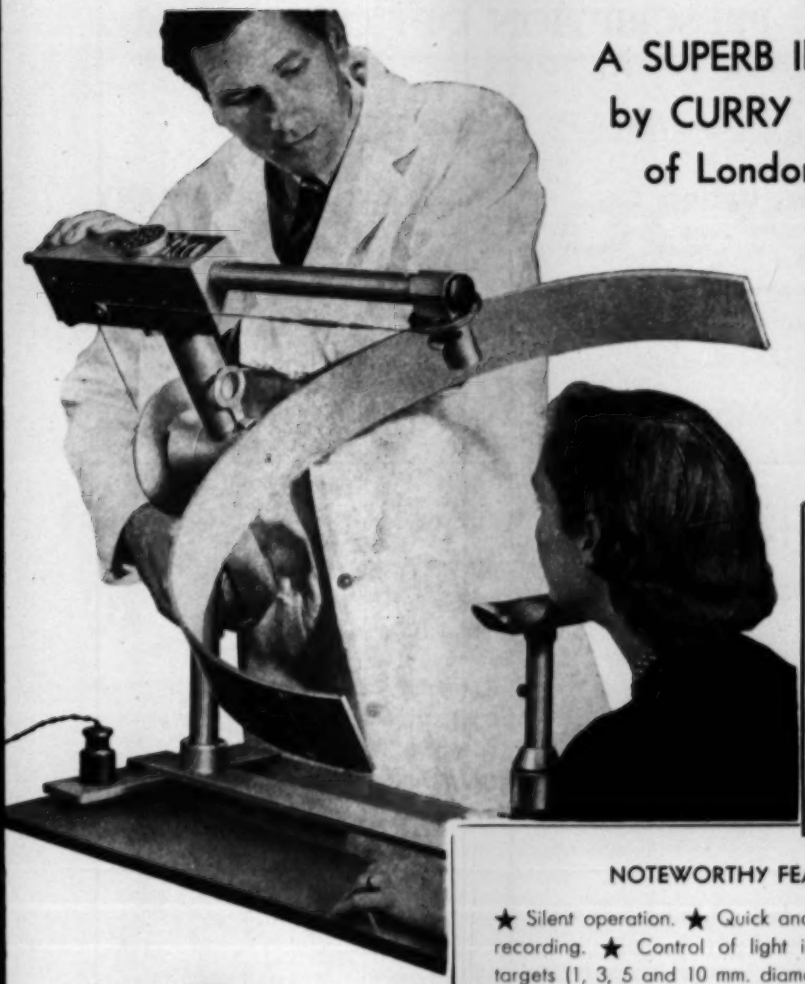

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1. Rasgorshek, R. H., and McIntire, W. C.: Am. J. Ophth. *40*:34 (July) 1955.
2. Council on Pharmacy and Chemistry, A.M.A.: New and Nonofficial Remedies, Philadelphia, J. B. Lippincott Company, 1955, p. 263.
3. Gettes, B. C.: A.M.A. Arch. Ophth. *51*:467 (April) 1954.
4. Gordon, D. M., and Ehrenberg, M. H.: Am. J. Ophth. *38*:831 (Dec.) 1954 (a review of 8 studies covering 1035 patients).

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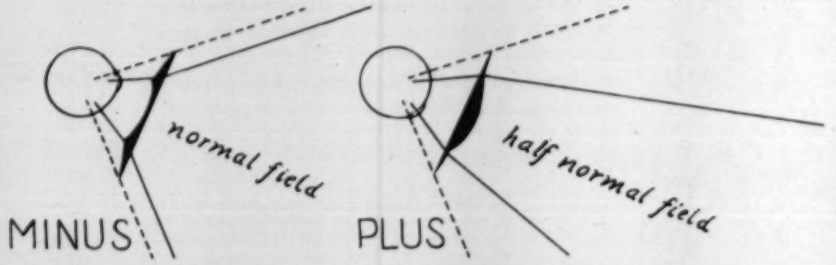
The converse is true in the case of strong plus lenses. As the eye again approaches the edge of the allowable field of vision with a strong plus lenticular, the greater the base in prism. Consequently, the bending of the light rays toward the center results in a constriction of the field of vision.




From these basic facts, the conclusion is obvious that due to the increased field of vision in minus lenses, the use of lenticular form is desirable. However, in strong plus lenses—particularly cataract lenses—due to the restricted field of vision the lenticular form is not advised.

Our next Scientific Corner article will discuss the various types of cataract lenses—their advantages and disadvantages.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AMERICAN JOURNAL OF OPHTHALMOLOGY

SERIES 3 · VOLUME 41 · NUMBER 5 · MAY, 1956

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ABSTRACTS

Anatomy, embryology, and comparative ophthalmology; General pathology, bacteriology, immunology; Vegetative physiology, biochemistry, pharmacology, toxicology; Physiologic optics, refraction, color vision; Diagnosis and therapy; Ocular motility; Conjunctiva, cornea, sclera; Uvea, sympathetic disease, aqueous; Glaucoma and ocular tension; Crystalline lens; Retina and vitreous ..... 884

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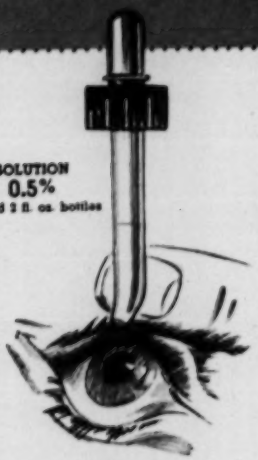
# In Acute Emergencies of the Eye



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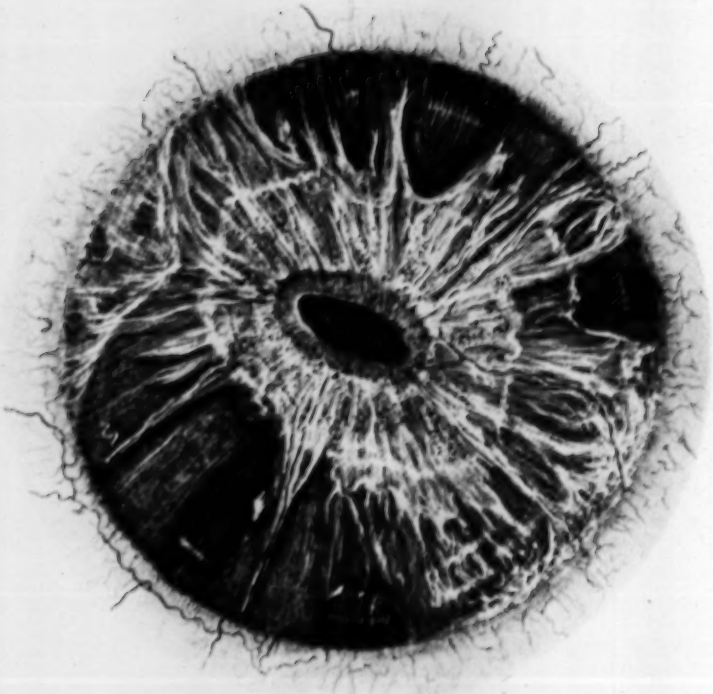


Plate I (Callahan). Left eye, showing multiple abnormalities of the iris.

AMERICAN JOURNAL OF OPHTHALMOLOGY

VOLUME 41 MAY, 1956 NUMBER 5

# MULTIPLE ABNORMALITIES OF THE IRIS

*(Mesodermal tissue, atrophy and holes)*

WITH SECONDARY GLAUCOMA AND DEAFNESS

*(Histologic examination of one eye)*

ALSTON CALLAHAN, M.D.

*Birmingham, Alabama*

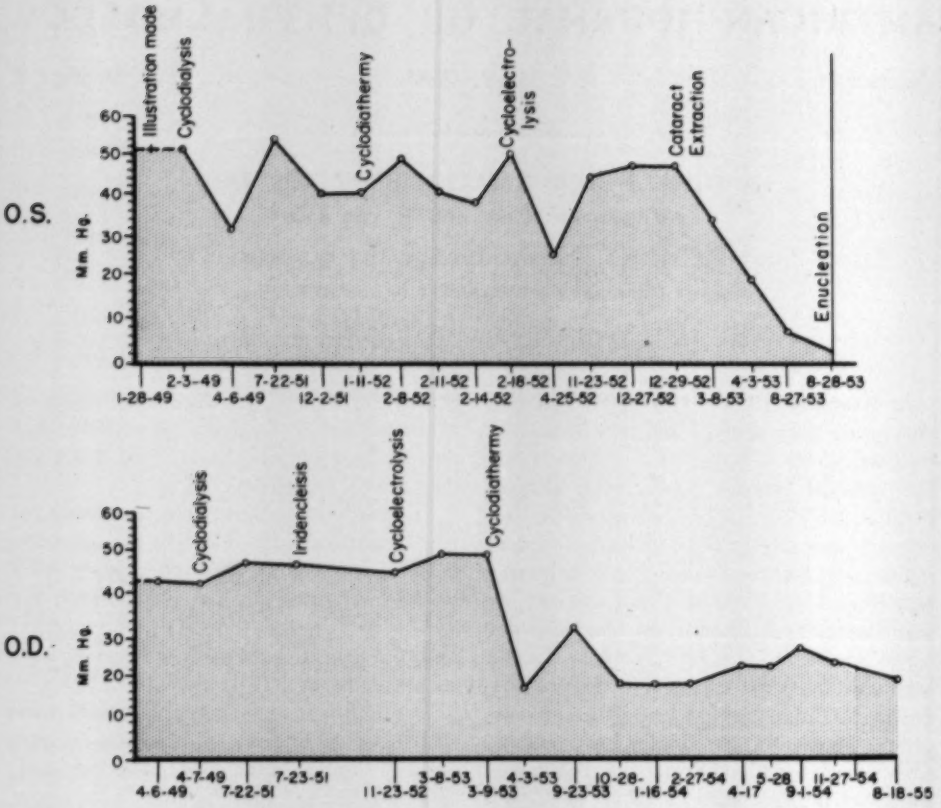
In February, 1949, a 15-year-old girl was examined for ocular defects. She had weighed 3.5 lb. at birth, which occurred two and one-half months prematurely. During pregnancy her mother had had nephritis. The delivery was accomplished at home and during the first few months of life the baby was kept in an improvised incubator. No oxygen was administered. She had complete bilateral nerve deafness from birth, and has never been able to speak. Except for this and her ocular condition there were no other congenital anomalies. No sibling has congenital ocular defects, and there was no consanguinity of the parents.

On examination, both corneas measured 12 mm. in diameter. Neither was cloudy. Alternating esotropia (35 degrees) was present and fixation with the right eye was preferred. The pupillary reflex to light was slight, the consensual reflex of the right eye was normal, but in the left eye this could not be demonstrated. Extensive mesodermal vascular and connective tissue covered the lesser circle of the iris and seemed to fill the angles of both eyes. There was a fusiform peripheral hole of the right iris at the 9-o'clock position and the left iris showed five peripheral holes extending across the greater circle of the iris (plate 1). The pupillary opening of the left iris was elliptic in shape and diagonally placed. The media were clear. Glaucomatous cupping was present in both eyes, and the central vessels were displaced nasally. These changes were more advanced in the left eye. It seemed most probable that the secondary glaucoma resulted from the mesodermal anomalies.

Surgical and medical management was begun immediately. To simplify the presentation of the course of events from 1949 through August, 1955, graphs of each eye have been constructed to show the surgical procedures performed and the resulting ocular tension (graphs 1 and 2).

The technique of the cyclodialyses consisted of making the scleral incision six mm. from the limbus in the upper temporal quadrant, rupturing the scleral spur in the upper outer quadrant, and injecting air into the anterior chamber; the iridencleisis was performed at the 12-o'clock limbus with incarceration of both pillars; the cycloelectrolysis was performed upon the lower half of the ciliary body from the 3- to 9-o'clock positions, about 25 transcleral punctures being made seven to eight mm. from the limbus; and the cyclodiathermy was done in the upper nasal quadrant. A single row of nonpenetrating burns was made from the 12- to 3-o'clock position, each about 1.5 mm. apart (the standard Walker diathermy was set at 45). This last procedure, with perhaps some effect of the preceding operations, controlled the tension.

In September, 1953, a mature cataract was removed from the left eye. At the operation there was small vitreous loss, but no compli-




Graphs 1 and 2 (Callahan). Ocular tension and surgical procedures on eyes of E. K.

cation occurred to account for the rapidly developing phthisis bulbi. The eye was enucleated. The sections were kindly read by Dr. Bertha Klien:

### Histologic findings

The corneal epithelium is slightly irregular, mostly thinner than normal in the center due to flattening of its foot cells. In one place there is dense superficial infiltration with polymorphs and round cells. Bowman's membrane is missing in this area, over which the epithelium shows a circumscribed thickening. There is slight diffuse infiltration of the cornea with lymphocytes and some polymorphs. At the limbus on one side there is a broad penetrating scar to whose inner end a mass of fibrous tissue is attached. Lens cortex and capsule and vitreous are drawn up to and incarcerated within this mass. Behind the limbus, on the side of the penetrating scar, there is an extreme thinning of the sclera which here bulges slightly outward. This scleral ectasia extends backward to the equatorial region.

There are only remnants of the iris visible, mainly the portions containing the sphincter, and some of the posterior layers, especially the pigment epithelium which, in some places, is the sole remaining structure. The remnants of the pupillary portion, which contains the sphincter, have a very distinct lining of endothelium and a thin Descemet-like substance over the anterior surface (fig. 1).

The angle of the anterior chamber is closed partly by fibrous masses above, partly by a thick, glassy substance which is continuous with Descemet's membrane. This homogeneous substance appears intimately connected with the fibers of the trabecula (fig. 2) and extends also over the remnants of the iris root. It is particularly thick over the trabeculae where it forms a group of wartlike excrescences. On the inside this entire formation of glassy substance is lined by proliferated corneal endothelial cells, some of which show hydropic degeneration, and by a thin layer of newly formed Descemet's membrane (fig. 3). The latter, to judge from its

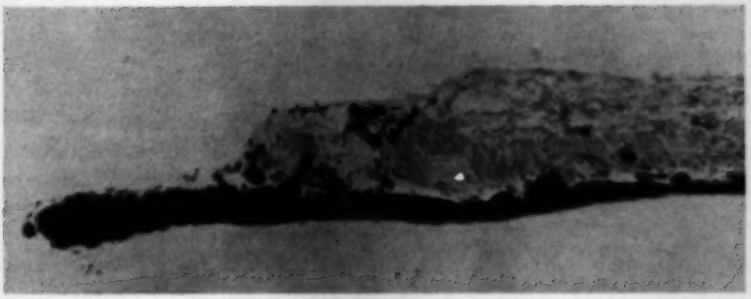


Fig. 1 (Callahan). Only remnants of the iris are present.

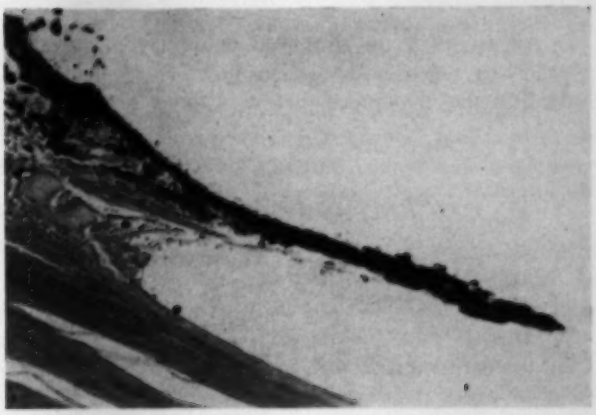


Fig. 2 (Callahan). The anterior chamber angle is closed by a thick, glassy substance continuous with Descemet's membrane.

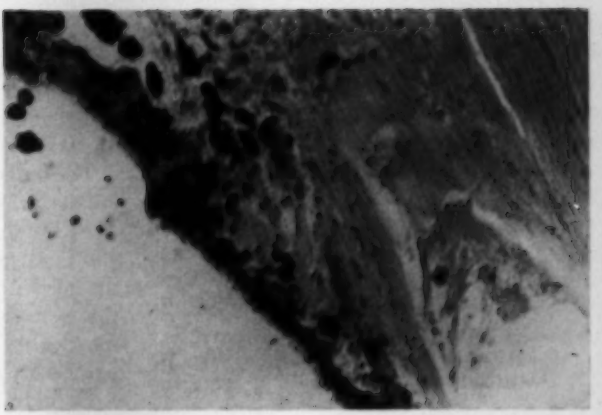


Fig. 3 (Callahan). The glassy substance is lined by proliferated corneal endothelial cells.

topographic relations, is of much more recent origin than the deeper lying glassy masses, which may be the formations originally seen as the grayish network on the anterior surface of the iris.

The ciliary body is extremely necrotic and moderately infiltrated with lymphocytes.

There is an extensive posterior vitreous detachment. Cell conglomerations, mainly lymphocytes, monocytes, macrophages, and polymorphs, are suspended in aqueous and vitreous and line the posterior corneal surface, the zonular fibers, the posterior surface of the vitreous and the inner surfaces of ciliary body and retina.

Just behind the inferior ora serrata there is a circumscribed low retinal detachment. Otherwise the retina is well preserved with a moderate degree of periphlebitis.

The optic papilla is not shown in the sections.

Diagnosis: Scleral ectasia (secondary glaucoma), incipient atrophia bulbi, iris atrophy (possibly primary).

In August, 1955, the tension of the right eye had been normalized for more than two years following the cyclodiathermy. Miotics were not required. The visual acuity retained with correction ($-13.75$D. sph. $\bigcirc$ $-2.0$D. cyl. ax. 20°) is 20/30.


## Summary

A 15-year-old patient with bilateral multiple abnormalities of the iris with secondary glaucoma and deafness is presented. Repeated surgical procedures failed to save one eye and, after a cataract was removed from it, phthisis bulbi developed rapidly. Histologic studies were made of the enucleated eye. Useful vision was maintained in the other eye by four surgical procedures, the last and most successful of which was a cyclodiathermy.


*903 South 21st Street.*

The anterior segment painting is by Mrs. Mary Nichol Burnham.

---

# CARDIAC ARREST DURING STRABISMUS SURGERY*

### A PRELIMINARY REPORT

E. JOHN SORENSON, M.D., AND JOHN E. GILMORE, M.D.
*Santa Monica, California*

Cardiac arrest is an alarming emergency. To be faced with it during routine strabismus surgery is a frightening experience for both surgeon and anesthetist. What at first seemed to be a typically unexplained cardiac arrest was subsequently accounted for in an entirely unexpected manner. It was possible to continue the operation following cardiac arrest, but bradycardia returned as soon as tension was again placed on the medial rectus muscle. This observation was later confirmed in a series of strabismus operations, and it has been established that various types of arrhythmias occur with mobilization of the recti muscles, particularly the medial rectus muscle.

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## Case report

J. M., a girl, aged three years, was operated for strabismus. Bilateral recession of the medial recti was performed. Premedication consisted of atropine, 1/200 gr., and codeine, 0.5 gr. Following induction with ether, the child was intubated and a mixture of ether and oxygen administered. As a special precaution the radial pulse was palpated by the anesthetist throughout the operation.

The pulse rate remained normal at 120 per minute, while the conjunctiva was being incised and the medial rectus muscle identified and isolated. When tension was exerted on the medial rectus, the pulse rate suddenly dropped to 20. With further pull on the muscle the child became pulseless, and cardiac arrest occurred.

Surgery was interrupted, and rhythmic

thumping on the chest brought the pulse immediately back to the former rate of 120 per minute. When upon resumption of the operation, the medial rectus was again stretched, bradycardia recurred, with a drop of the pulse rate to 40 per minute. Upon release of tension the pulse rate returned to normal. This cycle was repeated one or two times during the operation. Surgery was continued successfully with as little tension as possible on the medial recti muscle.

There was no further untoward incident, either during surgery or postoperatively.

### Comment

From that time on arrhythmias of various types were observed in every case of operation for strabismus. The radial pulse was consistently checked and, in addition, the action of the heart muscle was followed on an electrocardioscope. In a consecutive unselected series of 17 cases, bradycardia occurred in 16 patients, in seven of whom it was combined with extrasystoles; in the remaining case, there occurred ventricular fibrillation.

The pattern of bradycardia was quite consistent. In 15 cases, the pulse rate before isolation of the medial or lateral rectus was between 110 and 130, and dropped with tension on the muscle to a range between 40 and 65 (average 49.4); in one case the pulse prior to mobilization of the muscle was 72 and fell with tension on the muscle to 25, accompanied by extrasystoles.

All patients in this series were children or adolescents, the oldest being 18 years of age; none of them presented a history of earlier cardiac disturbances. Arrhythmia occurred with any operative technique and irrespective of the premedication used. In 10 instances, the operation was bilateral; in seven, a unilateral muscle tuck of the medial or lateral rectus was performed.

Bradycardia and other types of arrhythmias developed with tension on the muscle during mobilization, whether preparatory to lengthening or shortening of the muscle. It would appear that tension on the medial rectus is more likely to produce arrhythmia than mobilization of the lateral rectus. The phenomenon did not cease when scopolamine was substituted for atropine, and methadon for codeine.

In each instance, bradycardia, extrasystoles, or ventricular fibrillation terminated as soon as tension on the rectus was released. Arrhythmia was also controlled by intravenous injection of atropine (1/150 gr.) effectively blocking vagal stimulation.

### Discussion

It is planned to continue the study of arrhythmias incidental to mobilization of the medial and lateral rectus muscles. In particular electrocardiographic tracings of future cases will be analyzed in order to identify more precisely the various arrhythmias occurring during strabismus operations. However, certain conclusions are already possible on the basis of the 17 cases reported in the foregoing.

Bradycardia and—more rarely—extrasystoles and ventricular fibrillation are directly related to mobilization of the medial and/or lateral rectus oculi. It is therefore necessary to watch the patient's pulse closely while this maneuver is being performed. A sudden drop in the pulse rate calls for immediate release of tension before—as in the first case of our series—cardiac arrest occurs. The surgical team is therefore provided with an invaluable premonitory sign which warns of serious complications ahead.

By the same token, it seems that the danger of a cardiac emergency is increased in a patient with an initially low pulse rate. In one case of this series the pulse was as low as 72 when the conjunctiva was being incised, and dropped with mobilization of the right rectus lateralis to the dangerous level of 25 beats per minute. Any marked decline in the pulse rate, therefore, calls for immediate supportive measures, before the surgeon proceeds to mobilization of the rectus oculi.

While cardiac arrest requires the well-established emergency measures, bradycardia after mobilization of the rectus oculi is instantly relieved by release of the pull on the muscle, and the pulse returns within seconds to a safe level.

From the observations in this series it must be concluded that some degree of bradycardia inevitably occurs every time that the medial and/or lateral rectus is stretched. As manipulation of the recti is an integral part of squint correction, the medial and lateral recti must be handled with more than usual care. If pull on the muscle is kept down to the absolute minimum, the pulse rate will rarely drop below 90 beats per minute. Such a marginal level of bradycardia during the few minutes required for work on the recti will not cause permanent damage, particularly as this slight myocardial upset ends as soon as the recti returns to a physiologic position. But even when the ocular muscles are handled with a very light touch the pulse rate should be carefully watched in order to detect at once any unexpected aggravation of bradycardia.

The findings in the present series suggest that fatalities during strabismus operations might well be due to hitherto unrecognized bradycardia following mobilization of the medial and/or lateral rectus oculi. In the past such cases have been ascribed to anesthesia, as for instance in a recently published report from Monroe, Wisconsin:[4]

> A boy, five years of age, underwent a strabismus operation on the right eye. Nothing unusual occurred until resection of the lateral rectus muscle had been completed and an incision for resection of the medial rectus was made. At that moment the anesthetist noted considerable mucus in the pharynx, and while she attempted to remove it by suction, the patient became cyanotic. Pulse, blood pressure, and heart tones were absent.
>
> In a paper discussing the same case, Betlach[4] stated that the pulse rate had previously been of good quality, and regular at 140 beats per minute. Neither of these two reports mentions the relationship between cardiac arrest and mobilization of the medial rectus; in fact, Betlach's paper omits all details of the operative procedure, and ascribes cardiac arrest to obstruction of the airway.

The physiologic basis of arrhythmia following pull on the medial and/or lateral rectus oculi is probably the same as that of the oculocardiac reflex. In 1908, Dagnini and, independent of him, Aschner discovered that pressure on the eyeball results in slowing of the radial pulse.

Through animal experiments Aschner[1] established that the efferent limb of this reflex arc consists of the vagus nerve, while the trigeminal nerve constitutes the afferent limb. Section of the optic, olfactory, oculomotor, trochlear, abducens, acoustic, and facial nerves had no effect on the oculocardiac reflex. Visualization of the heart demonstrated that pressure upon the eye produced considerable retardation of the pulse rhythm, and a decrease in the magnitude of cardiac contractions. With stronger pressure upon the eye, temporary cardiac arrest during diastole developed.

Aschner showed that the oculocardiac reflex is brought on by mechanical stimulation of the trigeminus; when following enucleation of the globe a branch of the trigeminal nerve in the orbit was subjected to pressure or stretching, the oculocardiac reflex resulted promptly. Another important finding was that the reflex is more pronounced and more easily produced under anesthesia than in the waking state.

Aschner's experimental observations were subsequently confirmed in the course of ophthalmic surgery. For instance, Bailey[2] reported, in 1935, precordial distress following enucleation of the right eye of a 31-year-old man; during section of the optic nerve, there occurred severe hemorrhage which was controlled by sealing the conjunctival wound with a watertight suture. Within a few minutes the pulse slowed down to a rate of 30, and frequently a beat was lost. Bailey writes that suddenly it dawned upon him that he "was confronted with a very much exaggerated oculocardiac reflex brought about by the extreme pressure of the blood imprisoned in the orbit which had no means of exit."

A similar case was contributed in the same year by Vialard[15]: Five or six hours after enucleation of the left eye of a 30-year-old

man, there developed bradycardia (pulse 40 per minute), which persisted until the ocular bandage was changed three days later. At that time it was discovered that blood had accumulated under a small sponge, and with drainage the heart rhythm as well as the pulse rate returned to normal. Subsequent cardiologic examination revealed no lasting damage.

Mérigot de Treigny[10] encountered a case of bradycardia (pulse rate 30 per minute) following marked hemorrhage in the course of enucleation of the left eye. In this instance local decompression proved ineffective, but orbital injection of novocaine brought the pulse rate back to 60 per minute. Subconjunctival hematoma may also elicit a spontaneous oculocardiac reflex, as in a case reported by Störtebecker.[14] Four hours after receiving a blow to the eye the patient's pulse had slowed down to 36 per minute. Electrocardiographic tracings showed a nodal type of rhythm as well as arrhythmia with a prolonged compensatory period.

On the strength of Aschner's experiments in animals and observations following intraorbital and subconjunctival hematomas it has been established that the oculocardiac reflex is elicited by pressure on retrobulbar structures.

The findings in the present series suggest that a similar effect is produced by stretching of the lateral—and still more so of the medial rectus oculi. As Aschner's experiments have demonstrated that the oculocardiac reflex persists after severance of the oculomotor and/or abducens nerves, his conclusion is plausible that the oculocardiac reflex is due to stimulation of the first division of the trigeminal, the ophthalmic nerve.

All trigeminal divisions carry with them sympathetic and parasympathetic components.[8] In particular, parasympathetic fibers are present in the ciliary ganglion and in the ciliary nerves.[9] While definitive confirmation through animal experiments is still lacking, it may be presumed on clinical grounds that tension of the medial and/or lateral rectus oculi is transferred to these terminal parts of the trigeminal nerve, and hence reaches the vagus and its cardiac branches.

The findings in the present series are at one point definitely at variance with earlier observations regarding the oculocardiac reflex. Aschner[1] found that pressure upon one eye produces the reflex only to a lesser degree than when pressure is exerted on both eyes. Mérigot de Treigny[10] stated that strong compression (600-800 gm.) is required in order to elicit the oculocardiac reflex. It has been our observation that even very slight unilateral tension on the medial and/or lateral rectus oculi will consistently result in a minor degree of bradycardia. Perhaps stretching of these muscles stimulates the terminal branches of the trigeminal nerve more forcefully then pressure on the globe or from an intraorbital or subconjunctival hematoma.

In one case of the present series, stretching of the rectus oculi resulted in ventricular fibrillation, as against the more common response of bradycardia and extrasystoles. Ventricular fibrillation of an almost fatal degree, resulting from pressure upon the eyeball, has been reported by Landman and Ehrenfeld.[7] It remains to be seen whether the oculocardiac reflex produced by direct stimulation is subject to the same variations of myocardial response as demonstrated by Sabena and Posteli[13] following pressure on the globe.

The vagal tone reaches its peak during adolescence and early adulthood,[5] and the oculocardiac reflex is positive in 90 percent of all children.[6] Physiologic vagotonia may thus account for bradycardia observed with stretching of the medial and/or lateral rectus oculi during strabismus operations. The oculocardiac reflex, furthermore, is more easily produced under anesthesia than in the waking state, as already observed by Aschner.[1]

A new concept of the relationship of anesthesia to cardiac arrest from vagal stimulation has been proposed by Reid and his

group.[11] They point out that a healthy normal heart will never respond to vagal stimulation with serious symptoms. Anesthesia, however, depresses the functional capacity of specific tissue fibers in the myocardium and renders the heart as vulnerable to vagal stimulation as in the presence of diffuse organic lesions. While Reid and his co-workers do not mention vagal stimulation originating from the retrobulbar branches of the trigeminus, their deductions seem to be applicable to bradycardia and cardiac arrest occurring with mobilization of the ocular recti.

Preoperative use of atropine, for the purpose of depressing the parasympathetic nerves, has been recommended as a safeguard against acute circulatory emergencies.[12] In our series premedication with atropine (1/150 to 1/200 gr.) was used in seven cases, but proved ineffective in preventing bradycardia with or without extrasystoles. Codeine was no more satisfactory, but intravenous injection of atropine (1/150 gr.) resulted in prompt vagus release.

## Summary and Conclusions

Tension on the medial and/or lateral rectus oculi with mobilization of the muscle in the course of strabismus operations resulted consistently in arrhythmia. In a series of 17 cases there was one instance of ventricular fibrillation, while all others presented varying degrees of bradycardia, sometimes combined with extrasystoles. In one case cardiac arrest occurred with continued pull on the medial rectus.

It has been demonstrated that even slight stretching of the medial and/or lateral rectus oculi is attended by some degree of arrhythmia; thus special care is required in isolating and dissecting these muscles.

Hitherto unexplained accidents during strabismus operations might conceivably be due to myocardial crises from excessive tension on the medial and/or lateral rectus oculi. The response seems to be closely related to the oculocardiac reflex, and is probably traceable to stimulation of terminal branches of the trigeminal nerve, which in turn activate the vagus. During strabismus operations the response is exaggerated to a dangerous degree, owing to the physiologic vagotonia of children and adolescents, and the effect of anesthesia on the myocardium.

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# SOME OCULAR SEQUELAE OF TUBERCULOUS MENINGITIS

## A PRELIMINARY SURVEY, 1953-54

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Dr. Frank Walsh in his *Clinical Neuro-ophthalmology*, published in the United States in October, 1947, when discussing tuberculous meningitis, stated that:

1. "A vast majority of patients die from the disease but a few well-authenticated recoveries have been recorded—there is no effective treatment.

2. "Papilledema if it occurs at all in these cases does so rarely.

3. "Miliary tubercles of the choroid are frequently observed a short time before death. It is rare that an individual with chorioidal tubercles recovers.

4. "Atrophy of the optic nerve is rarely if ever seen, since there is insufficient time for atrophy to develop before death occurs."

As these statements have been made by a neuro-ophthalmologist of high international standing you can take it that this was the state of affairs relating to tuberculous meningitis and some of its ocular sequelae only seven years ago. What is the position to-day?

Thanks to modern therapy—Streptomycin, P.A.S., and I.N.H.—the survival rate is now about 80 percent and, as a result of this, eye complications which were practically unknown seven years ago are now a frequent occurrence. Within the past 15 months I have examined 65 cases of tuberculous meningitis, 53 of which were in the Dublin Fever Hospital, nine in Clonskeagh Fever Hospital, two in the Richmond Hospital, and one in Rialto Chest Hospital.

Of these, 47, or 72 percent, had ocular lesions, some of which were multiple (table 1).

TABLE 1

EYE FINDINGS IN 65 CASES OF TUBERCULOUS MENINGITIS

| Eye Findings | Cases | Percent |
|---|---|---|
| Eye complications | 47 | 72 |
| Papilledema | 17 | 26 |
| Chorioidal tubercles | 16 | 25 |
| Pale discs | 13 | 20 |
| Ocular palsies | 10 | 15.5 |
| Retrobulbar neuritis | 2 | 3.1 |
| Homonymous hemianopsia | 1 | 1.5 |
| Neurosurgery performed | 12 | 18.5 |
| Mortality | 1 | 8.3 |
| Of the 65 patients examined 6 died from meningitis | | 9.2 |

If BCG inoculation fulfils the claims made for it, tuberculosis, including tuberculous meningitis, may cease to be a therapeutic problem within the next 15 or 20 years. But until this prophylactic hope materializes it is not unreasonable to anticipate a still higher survival rate in tuberculous meningitis with its ocular sequelae, unless a rapid cure is effected, in which event these sequelae may not arise.

Within the past five years or so cases of these ocular manifestations have been reported in the medical literature, but I have been unable to find a paper dealing with the cause, prevention, and treatment of these complications. The present investigation was undertaken in order to ascertain why these complications develop and also to evolve some suitable prophylatic or curative treatment. I regret to say that these aims have only been partly achieved but perhaps some day it may be possible to present more spectacular results.

We have here a new problem which may become more urgent in the near future and I think it is unfair to dismiss it by saying it is the price the sufferers have to pay for survival.

I am indebted to the staff of the neurosurgical unit of the Richmond Hospital for their kind assistance in operating on these patients; without their co-operation the presentation of this paper would not have been possible. I am particularly grateful to Mr. Lanigan for his help all through the investigation.

You will see from Table 2 that papille-

TABLE 2

DATA ON 65 CASES OF TUBERCULOUS MENINGITIS

| Case | Days Ill before Admission | I.M. Streptomycin (gm.) | I.T. Streptomycin (mg.) | PAS (gm.) | INH (mg.) | Age (years) | Deaf | Ocular Complications | Day of Onset after Admission | Chest X-ray Studies | Neurosurgery | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 14 | 240 | 4,100 | 7,290 | 85,000 | 19 | — | Chorioidal tubercles, pale discs | Within 2 mo. | Miliary | + | |
| 2 | 4 | 287 | 2,900 | 123 | 77,100 | 18 | — | Pale discs | 13th mo. | Healed T.B. | + | Treatment was broken on 4 occasions |
| 3 | 12 | 48 | 5,300 | | | 1¾ | — | Pale discs (first examination 87 days after admission | ? | Negative | + | |
| 4 | 140 | 26 | | | 3,100 | 8½ | — | Chorioidal tubercles & papilledeams (first exam. 3.5 mo. after admission) | ? | Miliary | ++ | Died |
| 5 | 11 | 204 | | | 2,100 | 12 | — | None (first seen 10 mo. after admission) | — | Negative | — | |
| 6 | 14 | 96 | 4,800 | | 4,400 | 9 | + | Pale discs (first exam. 7 mo. after admission) | ? | Negative | + | |
| 7 | 3 | 114 | | | 19,200 | 18 | — | Papilledema & partial 3rd nerve palsy | 28 | Negative | — | |
| 8 | 7 | 74 | | | 7,400 | 8 | — | Chorioidal tubercles (first exam. 39 days after admission) | ? | Miliary | — | |
| 9 | 3 | 80 | | | 16,000 | 13 | — | None (first exam. 43 days after admission) | — | Negative | — | |
| 10 | 10 | 101 | | | 31,200 | 17 | — | Papilledema & chorioidal tubercles (first exam. 40 days after admission) | ? | Miliary | — | |
| 11 | 6 | 153 | | | 28,400 | 45 | — | None | — | Negative | — | |
| 12 | 28 | 120 | 3,100 | | 17,700 | 23 | — | Pale discs | First seen 4th | Negative | + | |
| 13 | ? | 14 | 2,050 | | 3,500 | 1½ | — | 1 chorioidal tubercle | 4th | Negative | — | Died |
| 14 | 21 | 262 | 10,400 | | 68,300 | 47 | + | None | — | Negative | — | |
| 15 | 6 | 167 | | | 77,000 | 27 | — | None | — | Miliary | — | |
| 16 | 6 | 80 | 7,400 | | 96,050 | 7 | — | Chorioidal tubercles | 3rd | Miliary | — | Died |
| 17 | 20 | 141 | 14,100 | | 51,150 | 6 | — | Chorioidal tubercles (first exam. 6 mo. after admission) | ? | Miliary | — | |
| 18 | 42 | 155 | 3,500 | | 7,100 | 7 | — | Papilledema | 2nd | Primary | + | |
| 19 | 35 | 9 | 500 | | 1,100 | 10 | — | Papilledema | 5th | — | — | Died |
| 20 | 5 | 15 | 2,700 | | 5,450 | 10/12 | — | Retinal edema, 10th day 3rd nerve palsy, 24th day | 10th | | — | Died |
| 21 | 4 | 2 | 500 | | 550 | 5/12 | — | None | — | | — | Died |
| 22 | ? | 56 | 500 | 23 | 1,000 | 11/12 | — | Papilledema | 2nd | | — | Died |

TABLE 2—(*continued*)

| Case | Days Ill before Admission | I.M. Streptomycin (gm.) | I.T. Streptomycin (mg.) | PAS (gm.) | INH (mg.) | Age (years) | Deaf | Ocular Complications | Day of Onset after Admission | Chest X-ray Studies | Neurosurgery | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23 | 49 | 133 | 6,500 | 1,104 | 55,950 | 5 | — | Chorioidal tubercles | 1st | Miliary | — | |
| 24 | 7 | 232 | 12,200 | 8,284 | 2,150 | 19 | — | Chorioidal tubercles | 12th | Miliary | — | |
| 25 | 14 | 140 | 4,800 | | 888 | 14 | — | Chorioidal tubercles | 16th | Miliary | — | |
| 26 | 4 | 1,466 | 5,300 | 1,218 | 54,100 | 4 | — | 1 chorioidal tubercle | 24th | Miliary | — | |
| 27 | 14 | 90 | 5,800 | | 3,400 | 7/12 | — | None | — | Negative | — | |
| 28 | 21 | 117 | 7,100 | | 772 | 2¾ | — | Retrobulbar neuritis | 2nd | Negative | + | |
| 29 | 5 | 60 | 3,700 | 425 | 11,275 | 1¾ | — | Papilledema | 19th | Negative | — | |
| 30 | 42 | 108 | 8,500 | | 43,150 | 3½ | + | Pale discs | 10th | Primary | — | Bad risk |
| 31 | 14 | 251 | 8,100 | 228 | 22,400 | 15 | — | Bad vision, 4th day. Pale discs, 26th day. 3rd nerve palsy, 40th day | 4th | Negative | + | |
| 32 | 15 | 145 | 6,800 | 1,288 | 46,500 | 9 | — | Papilledema | 5th | Negative | — | |
| 33 | 14 | 135 | 5,600 | 1,622 | 3,875 | 4½ | — | Chorioidal tubercles | 2nd | Miliary | — | |
| 34 | 14 | 127 | 5,100 | 1,736 | 3,920 | 16 | — | Papilledema | 4th | Primary | — | |
| 35 | 8 | 68 | 7,100 | 1,534 | 1,900 | 7 | — | None | — | Negative | — | |
| 36 | 14 | 256 | 8,400 | 3,168 | 7,630 | 13 | — | Papilledema | 4th | Primary | — | |
| 37 | 120 (in Carlow) | 130 | 3,300 | 1,962 | 1,945 | 10 | — | Papilledema & ptosis | 3rd | Negative | — | |
| 38 | 7 | 256 | 8,500 | 7,254 | 8,080 | 20 | — | 6th nerve palsy | 1st | Primary | — | |
| 39 | 28 | 233 | 6,100 | | 55,000 | 18 | Partial | Bilateral 6th nerve palsy | 9th | Negative | — | |
| 40 | 140 (in Carlow) | 51 | | 1,140 | 1,515 | 6 | — | Papilledema & pale discs | 8th | | + | |
| 41 | ? | 240 | 300 | 3,144 | 5,260 | 14 | — | None | — | Primary | — | |
| 42 | 8 | 113 | 11,600 | | 10,490 | 10 | — | Pale discs (first exam. 2 yr. after admission) | ? | Negative | + | |
| 43 | 21 | 33 | 2,700 | 446 | 4,800 | 43 | — | 1 chorioidal tubercle | 12th | Negative | — | |
| 44 | 49 | 191 | 7,400 | 2,998 | 5,740 | 18 | — | None | — | Primary | — | |
| 45 | 28 | 56 | 3,800 | 300 | 16,800 | 20 | Partial | Chorioidal tubercle & 6th nerve palsy | 5th | Miliary | — | |
| 46 | 21 | 225 | 7,000 | | 1,934 | 17 | — | None | — | Miliary | — | |
| 47 | 21 | 242 | 7,700 | 3,084 | 76,700 | 16 | — | Papilledema & bilateral 6th nerve palsy | 4th | Negative | — | |
| 48 | 7 | 70 | 6,500 | 852 | 20,800 | 19 | — | Papilledema | 13th | Primary | — | |
| 49 | 12 | 27 | 4,300 | 1,039 | 89,250 | 3 | — | Homonymous hemianopsia & pale disc | 107th | Primary | — | E.E.G. negative |
| 50 | 7 | 102 | 37 | 1,214 | 30,750 | 5¼ | + | Pale discs & ptosis | 16th | | — | |
| 51 | 21 | 44 | 2,700 | 544 | 12,100 | 2 | — | None | — | Primary | — | |
| 52 | 42 | 197 | 5,700 | | 33,500 | 8 | — | None | — | Primary | — | |
| 53 | 13 | 292 | 10,000 | 2,996 | 68,400 | 18 | — | Retinitis pigmentosa & waxy discs | 6th | | — | |
| 54 | ? | 105 | 7,200 | 1,418 | 40,200 | 4½ | — | Pale discs & 6th nerve (first exam. 78 days after admission) | ? | Negative | — | |

TABLE 2—(*continued*)

| Case | Days Ill before Admission | I.M. Streptomycin (gm.) | I.T. Streptomycin (mg.) | PAS (gm.) | INH (mg.) | Age (years) | Deaf | Ocular Complications | Day of Onset after Admission | Chest X-ray Studies | Neurosurgery | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 55 | ? | 117 | 7,500 | 2,968 | 70,700 | 18 | — | None | — | Primary | — | |
| 56 | 42 | 91 | 5,800 | 1,260 | 27,050 | 6 | — | None | — | Negative | — | |
| 57 | 70 | 145 | 6,400 | 2,000 | 65,000 | 21 | — | Papilledema & chorioidal tubercles | 17th | Miliary | + | |
| 58 | 4 | 12 | 1,600 | 160 | 3,550 | 7 | — | None | 2nd | Negative | — | |
| 59 | ? | 25 | 1,700 | 400 | 7,500 | 29 | — | None | 17th | T.B.+ | — | |
| 60 | 14 | 44 | 1,600 | 704 | 13,300 | 18 | — | Papilledema | 15th | Negative | — | |
| 61 | 168 | 64 | 2,400 | 1,848 | 19,250 | 5 | — | Retrobulbar neuritis | 2nd | Primary | — | |
| 62 | 21 | 23 | 2,400 | 276 | 5,750 | 2½ | — | Pale discs | 3rd | Negative | — | Bad risk |
| 63 | 7 | 118 | 11,700 | | 60,000 | 6 | + | None | — | Negative | — | |
| 64 | 7 | 75 | | 192 | 31,000 | 25 | — | Chorioidal tubercles | 6th | Miliary | — | |
| 65 | 16 | 31 | 2,000 | 186 | 5,700 | 6 | — | Papilledema | 5th | Negative | — | |

dema, chorioidal tubercles, and optic atrophy form the majority of the eye complications and the present study is concerned chiefly with these lesions. Ocular palsies are not uncommon but for some reason they generally clear up and are not amenable to neurosurgery in the ordinary way.

### Chorioidal tubercles

I propose to deal first with chorioidal tubercles. As you see they were present in 25 percent of cases of tuberculous meningitis. In 14 of these 16 cases the chest X-ray films showed evidence of miliary tuberculosis. In the other two only one tubercle was seen in the chorioid but these patients had a temperature which was typical of miliary tuberculosis.

The presence of chorioidal tubercles can, therefore, be taken as evidence of miliary tuberculosis and consequently are of diagnostic value. They are sometimes difficult to see and they present as small, slightly faded and stippled areas in the posterior half of the uveal tract, chiefly in the temporal half of the fundus. I have seen only one case where a tubercle was present at the macula so, fortunately, it is unusual for the vision to be affected. Even in cases where it is possible to count 10 or more tubercles there is no evidence of exudation into the vitreous.

If tubercles are to be used as a guide to prognosis, they must be carefully charted and for this reason I have small reproductions of the normal fundus, from Wilmer's *Atlas*, which can be gummed into the patient's hospital chart about every week. As no two fundi are exactly the same, these can only be regarded as a rough guide. The fundus examination must be meticulous, which is difficult in an uncooperative patient.

As a result of studying 16 cases of chorioidal tubercles, I have formed the opinion that they are a valuable supporting prognostic guide; new tubercles appear when the disease is active and with the disappearance of the pyrexia no fresh tubercles appear. Incidentally, many of the smaller tubercles

disappear completely without leaving any ophthalmoscopic evidence of their presence. Others leave small rounded pale areas with pigmented borders, and their only importance from the neurosurgical aspect is that, if they are increasing in number, neurosurgery might be contraindicated. Moreover in this stage the use of cortisone or ACTH might be contraindicated on account of the probable presence of active pulmonary lesions, although there is not general agreement on this point when the patient is getting streptomycin and INH.

### Papilledema and pale discs

We will now pass on to the two ocular findings that are of neurosurgical interest; papilledema and pale discs.

Papilledema was present in 17 cases, or 26 percent. In some of these cases the edema was confined to the upper and lower disc margins and subsequently disappeared as the disease regressed. In others the swelling amounted to two or even three diopters and of these I had the impression that there were two varieties.

In the first, the disc presented a slightly pale serous-looking swelling not necessarily associated with a high cerebrospinal fluid pressure. This type of edema subsides as the disease is controlled and it is possible that this improvement is accelerated by repeated spinal punctures, which, I may add, can be performed without risk to the patient. The disc resumes its normal appearance and the vision is unaffected.

This condition is caused, I presume, by external hydrocephalus; the fluid passing down the vaginal space round the optic nerve and manifesting its presence on the disc. As the meningitis subsides the process is reversed.

In the second type the disc presents the typical florid appearance which is a familiar finding when there is increased intracranial pressure from brain tumor or internal hydrocephalus due to other causes. In this instance antibiotics and repeated spinal punctures fail to control the swelling, and I would not like to say that the latter procedure is free from the risk of causing death from displacement of a pressure cone. Moreover I see no reason why papilledema of this type should not go on to secondary atrophy if steps are not taken in time to relieve the increased intracranial pressure. I presume in these cases the tuberculous basal meningitis causes adhesions to form in the posterior fossa obstructing the flow of the cerebrospinal fluid from the fourth ventricle into the cisterna magna with resulting internal hydrocephalus.

Neurosurgery was carried out in four of the cases:

#### Case 57

M. G., aged 21 years, was 10 weeks ill before admission to hospital where the diagnosis of tuberculous meningitis was made.

On July 25, 1954, the fundi showed bilateral papilledema of three diopters. There were some round exudates on the surface of the right disc which may have been tubercles.

On August 1, 1954, the papilledema had increased to four diopters and there was a small chorioidal tubercle below the right disc. There was no gross field defect. In spite of the chorioidal tubercle transfer to the Richmond Hospital was recommended.

Figure 1 shows a normal anteroposterior ventriculogram; Figure 2, a normal lateral ventriculogram. Ventriculography demonstrated internal hydrocephalus (figs. 3 and 4).

On August 10, 1954, at operation both optic nerves were covered by material which resembled granulation tissue and which seemed to arise in the pituitary fossa (fig. 5). The nerves and chiasma were completely cleared and the operation completed by anterior third ventriculostomy. Figure 6 shows the operative approach through the lamina terminalis. She was discharged on the 11th postoperative day.

On September 5, 1954, the papilledema was two diopters and the chorioidal tubercle had healed. On September 19th, the papille-

Fig. 1 (Mooney). A normal anteroposterior ventriculogram.

Fig. 3 (Mooney). *Case 57.* Anteroposterior ventriculogram, demonstrating internal hydrocephalus.

Fig. 2 (Mooney). A normal lateral ventriculogram.

Fig. 4 (Mooney). *Case 57.* Lateral ventriculogram, demonstrating internal hydrocephalus.

dema was one diopter but there was a fresh chorioidal tubercle in the left fundus. On October 3rd, the discs were nearly flat and there were no fresh tubercles. On October 31st, the discs were flat and the tubercle had healed. There have been no fresh developments in the fundi and she has been very well since.

*Comment.* In spite of being in the active stage this patient stood operation well. It is not unreasonable to assume that this patient would have become blind from secondary optic atrophy due to unrelieved internal hydrocephalus had the operation not been performed.

CASE 4

J. B., aged eight and one-half years, was ill for five months before admission to hospital where the diagnosis of tuberculous meningitis was made.

On March 2, 1954, there were two diopters of papilledema in the right eye and one diopter in the left. The right fundus showed seven chorioidal tubercles and the left showed five. Transfer to the Richmond Hospital was advised on account of the papilledema and the long history and in spite of the presence of chorioidal tubercles.

On admission to the Richmond Hospital, the general condition was poor and there was

Fig. 5 (Mooney). *Case 57.* At operation both optic nerves were covered by material which resembled granulation tissue and which seemed to arise in the pituitary fossa.

spastic paraplegia with no power in either limb.

On March 23, 1954 ventriculography, showed a large internal hydrocephalus with patent aqueduct and fourth ventricle (figs. 7 and 8). The ventricular pressure was 230 mm. $H_2O$.

Posterior fossa craniotomy revealed extensive arachnoiditis extending down the spinal canal. The cisterna magna was opened widely and the patient was left with a decompression.

On March 30, 1954, an anterior third ventricle short circuit was carried out. Numerous soft adhesions were observed round both optic nerves and chiasma and were removed without difficulty. The patient died 48 hours after the operation, the only neurosurgical death in the series. Autopsy revealed extensive tuberculous meningitis with numerous miliary tubercles.

*Comment.* In spite of being a poor operative risk it was felt that an effort should be

Fig. 7 (Mooney). *Case 4.* Anteroposterior ventriculogram, demonstrating internal hydrocephalus.

Fig. 6 (Mooney). *Case 57.* The operative approach was through the lamina terminalis.

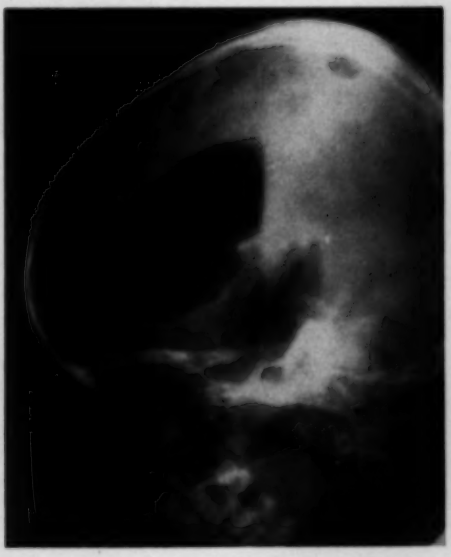

Fig. 8 (Mooney). *Case 4.* Lateral ventriculogram, demonstrating internal hydrocephalus.

made to relieve the internal hydrocephalus and avert blindness.

CASE 18

P. F., aged seven years, was ill for six weeks before admission to hospital where the diagnosis of tuberculous meningitis was made.

On May 23, 1954, one diopter of papilledema was present in each eye. No chorioidal tubercles were seen. On June 20th, the papilledema was two diopters in the right eye and 2.5 diopters in the left. On June 27th, this had increased to two diopters in the right eye and three diopters in the left. On July 4th, there were 2.5 diopters in the right eye and 3.5 in the left.

As the papilledema was increasing in spite of repeated spinal punctures, transfer to the neurosurgical unit was advised.

On July 8, 1954, right frontal craniotomy was performed (fig. 9). The chiasma and optic nerves were completely obscured by fine soft adhesions which were completely removed by gentle manipulation with pledgets of cotton wool. A moderate degree of internal hydrocephalus was dealt with by an anterior third ventriculostomy through the lamina terminalis. The child was discharged on the eighth postoperative day none the worse for the operative procedures carried out. The fundi returned to normal within two months.

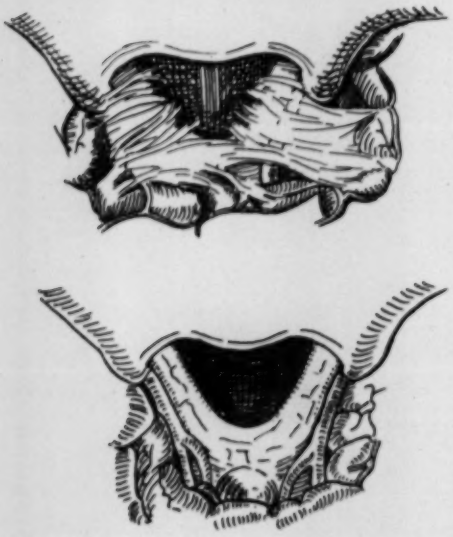

Fig. 9 (Mooney). *Case 18.* Findings at operation.

*Comment.* This is another instance in which neurosurgery by relieving the internal hydrocephalus probably saved the patient from blindness.

CASE 40

E. O'N., aged six years, was admitted to hospital having been under treatment in Carlow Fever Hospital for the previous five months.

On October 18, 1954, examination of the fundi showed bilateral papilledema of four diopters. Transfer to the neurosurgical unit was advised.

On October 28th, the chiasmal region was exposed after tapping a distended right lateral ventricle. Numerous fine adhesions which covered both optic nerves were easily wiped off by pledgets of cotton wool. There was one particularly firm band of adhesions running across the chiasma from the pituitary fossa which required a cutting hook to divide. The operation was completed by doing an anterior third ventriculostomy.

The child was discharged on the eighth postoperative day, having made an uneventful recovery.

On November 21, 1954, the papilledema had subsided to 1.5 diopters but there was slight pallor of the discs. On December 12th, the discs were flat with grade-2 pallor of the right disc and grade-1 of the left.

On February 27, 1955, there was grade-2 pallor of the right disc, the left being just off the normal color. Vision was difficult to assess but appeared to be quite good even in the right eye.

*Comment.* The short circuit operation probably saved this patient from blindness due to secondary optic atrophy. Pallor of the discs was not obvious when the discs were choked but presumably another poten-

tial cause of blindness was removed by clearing the adhesions from around the visual pathway.

Pallor of the discs with clear margins was present in 13 or 20 percent of the cases. This is a difficult problem to deal with satisfactorily in that it is difficult to decide in the first place whether neurosurgery is necessary and secondly when it should be carried out. As these patients are often very young, and in the early stages very ill, it is not usually practicable to assess the visual acuity. It is notoriously difficult to estimate the degree of vision from the appearance of the disc but it is the color of the disc, in an unco-operative patient, that is the deciding factor in referring the patient for neurosurgery.

Of the 13 patients in this group, two were considered too ill for surgery and they subsequently went blind (Cases 30 and 62).

One patient, aged three years, had right homonymous hemianopsia with grade-1 pallor of the right disc, the other disc being normal (Case 49). There was no deterioration in the fundus appearance in three months.

One patient, aged four and one-half years, had grade-2 pallor of the discs on July 25, 1954, and at that time she was not considered a suitable case for surgery. Eight months later the right disc was normal and there was grade-1 pallor of the left disc, the vision appearing to be quite good (Case 54).

Another patient, aged five and one-half years, had grade-1 pallor of the discs which remained unchanged for eight months, the vision being good all the time (Case 50). This patient was not considered bad enough to necessitate neurosurgery.

Yet another patient, aged six years, who had papilledema and pale discs has been described under papilledema (Case 40).

None of these except the last, for the reasons stated, were transferred to the neurosurgical unit. That left eight cases in which it was considered advisable to explore the optic nerves and chiasm in the hope that adhesions would be found interferring with the blood supply of this part of the visual pathway, the removal of which would either improve the vision or prevent it from getting worse.

CASE 1

E. D., aged 19 years, was admitted to hospital on August 3, 1951. When first seen by me on November 7, 1952, she had grade-3 pallor of the discs with clear margins and normal vessels. There were six chorioidal tubercles in the right fundus and seven in the left; none of these appeared to be of recent onset. The vision was: R.E., doubtful perception of light; L.E., hand movements in the peripheral field, there being a large macular loss.

Neurosurgery was recommended and on November 11, 1952, a right frontal craniotomy was carried out. Numerous fine adhesions over both optic nerves were removed by blunt dissection with pledgets of cotton wool.

A particularly firm calcified adhesion was seen running from the medial aspect of the right optic nerve across the chiasma close to its junction with the left optic nerve (fig. 10). This adhesion required a cutting hook to divide and its imprint on the left optic nerve was clearly observed. This patient was transferred back from the Richmond on the 13th day, none the worse for the operative procedures carried out.

On January 31, 1954, her vision was: R.E., hand movements above and below; L.E., counts fingers at three meters. Perime-

Fig. 10 (Mooney). *Case 1.* Findings at operation.

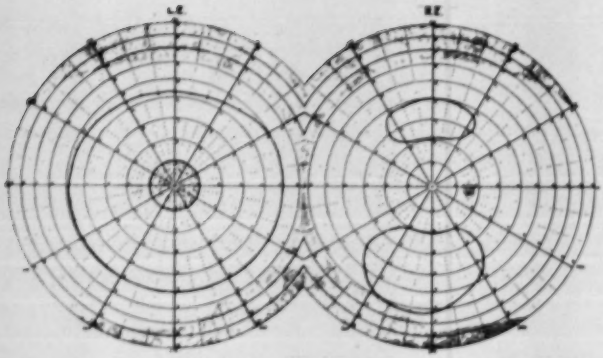

Fig. 11 (Mooney). *Case 1.* January 31, 1954. Vision: R.E., hand movements; L.E., counts fingers at three meters. Grade-3 pallor of discs. R.E., six chorioidal tubercles; L.E., seven chorioidal tubercles. 10/330 test object.

try (fig. 11) showed bilateral macular loss with good peripheral field in the left eye for 10/330.

On March 30, 1955, there was a marked improvement in the fields (fig. 12), the left field being almost full for 3/330 and 1/330 and the macular loss had diminished.

This girl who was practically blind before the operation can now go to dances and move around places with which she is familiar, unaided.

*Comment.* There can be very little doubt that the operation not only saved this patient from complete blindness but also restored useful vision in the left eye.

### Case 2

B. B., aged 18 years, was admitted to the Richmond Hospital on January 14, 1954, having been in the North Infirmary, Cork, since May 2, 1952. She had been treated there during four broken periods for tuberculous meningitis, having been ill for four days prior to her admission there.

On January 14, 1954, fundus examination showed grade-2 pallor of the discs and the patient was completely blind. On January 18th, right frontal craniotomy was performed.

The left optic nerve and chiasma were covered with granulation tissue which extended backward to be adherent to the lamina terminalis. When the granulation tissue was cleared away, the left optic nerve appeared thinner and rougher than the right nerve (fig. 13). There was no change in her vision when discharged.

On March 30, 1955, her vision was: R.E., hand movements below; L.E., counts fingers at one meter. The field (fig. 14) was fairly

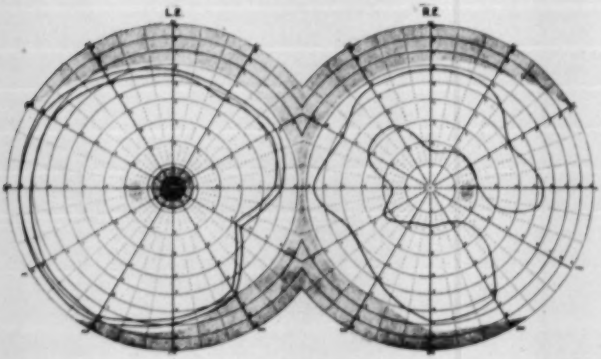

Fig. 12 (Mooney). *Case 1.* March 30, 1955. Vision: R.E., hand movements; L.E., counts fingers at four meters. Grade-3 pallor of discs. R.E., six chorioidal tubercles; L.E., seven chorioidal tubercles. Test objects: R.E., 10/330; L.E., 3/330 and 1/330.

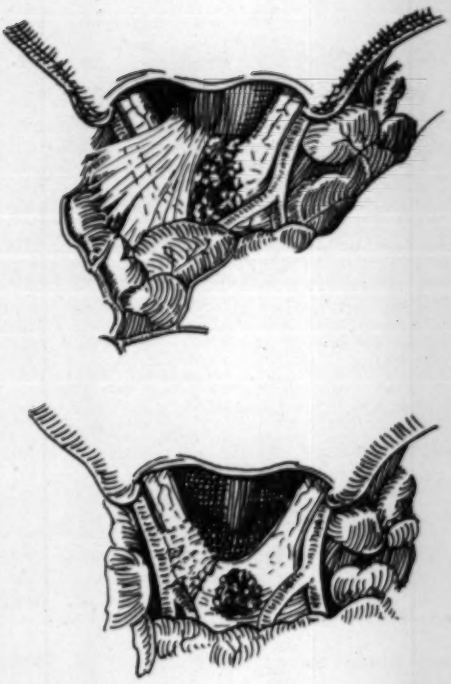

Fig. 13 (Mooney). *Case 2.* Findings at operation.

good for 10/330 but there was a large macular loss. She can move around indoors unaided.

*Comment.* This patient's treatment was interrupted on four occasions and defective vision was not noted for 13 months after admission to Cork Infirmary. In many respects she was similar to the previous patient and the fields after operation followed a similar pattern. Having regard to the late improvement that took place in the first patient, it is not unreasonable to expect it in this case also and her mother noticed a definite improvement during the two weeks prior to my last examination.

CASE 3

W. D., aged one year and nine months, was admitted to hospital on April 1, 1952, having been ill for 12 days prior to admission. A diagnosis of tuberculous meningitis was made.

On November 11, 1952, there was grade-2 pallor of the right disc and grade-3 pallor of the left. Vision was: R.E., perception of light in the temporal field; L.E., no perception of light. Neurosurgery was advised.

On November 13, 1952, right frontal craniotomy was performed and numerous adhesions over the optic nerves and chiasma were easily removed by blunt dissection with pledgets of cotton wool. The left nerve was slightly more involved than the right. The operation was completed by performing an anterior third ventricle short circuit through the lamina terminalis, there being a moderate degree of internal hydrocephalus. The patient was discharged on the ninth postoperative day.

When last seen two months later, the color of the discs had improved, the pupils reacted fairly well to light, and the vision appeared good. Three months subsequently a report

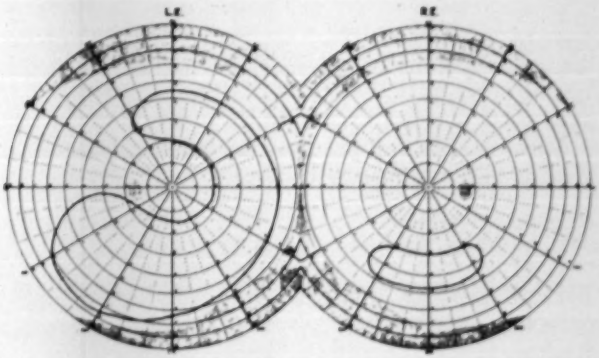

Fig. 14 (Mooney). *Case 2.* March 30, 1955. Vision: R.E., hand movements; L.E., counts fingers at one meter. Grade-3 pallor of discs. 10/330 test object.

from the Sunshine Home stated that the patient had made great progress and was able to run about, his intellect being quite normal.

*Comment.* Removal of the adhesions in this case restored good vision from almost complete blindness.

CASE 6

G. M., aged eight and one-half years, was admitted to hospital on April 16, 1953, having been ill for two weeks before admission. The diagnosis of tuberculous meningitis was made. On November 19, 1953, fundus examination showed slight temporal pallor of each disc but no chorioidal tubercles were seen.

On January 27, 1954, there was grade-1 pallor of each disc with clear margins. Neurosurgery was recommended but considered inadvisable on account of the patient's general condition. Subsequently this child became deaf.

On September 29, 1954, there was grade-2 pallor on the right disc and grade-3 pallor of the left, vision being only hand movements. Neurosurgery was again recommended.

On November 5, 1954, a right frontal craniotomy was performed and adhesions removed from the chiasma and optic nerves, especially the left. The operation was completed by performing an anterior third ventricle short circuit through the lamina terminalis. The patient was discharged on the eighth postoperative day.

This boy has been very well since. Visual assessment has been difficult on account of the deafness but he has no difficulty in reading the ordinary boys' comics behind which he is usually concealed whenever I visit him.

*Comment.* The operation was responsible for this boy recovering useful vision.

CASE 12

E. M., aged 23 years, was ill for eight weeks before admission to Dundalk Fever Hospital on January 12, 1954, and a diagnosis of tuberculous meningitis was made. He

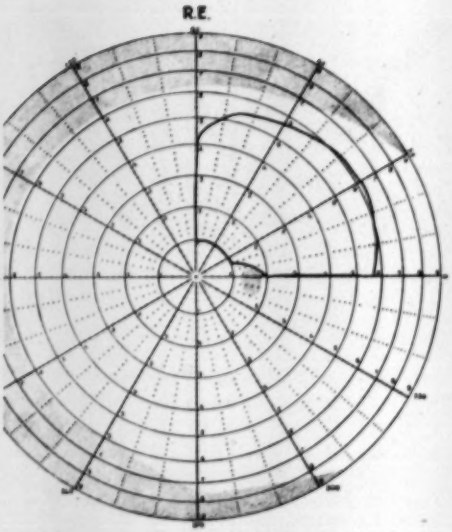


Fig. 15 (Mooney). *Case 12.* October 6, 1954. Vision: R.E., counts fingers at two feet in temporal field; L.E., nil. Grade-2 pallor of discs with clear margins and normal vessels. 5/330 test object.

was treated there until September 25, 1954, when he noticed that the left eye was blind. He was transferred to the Richmond Hospital.

On October 6, 1954, fundus examination showed grade-2 pallor of each disc. No chorioidal tubercles were seen. Vision was: R.E., counts fingers in the upper temporal quadrant; L.E., no perception of light. Figure 15 shows the right field for 5/330.

On October 8, 1954, a right frontal craniotomy was performed. There was no evidence of previous meningeal inflammatory process. The right optic nerve was normal in appearance up to near the chiasma. The left was grossly swollen to about one cm. in diameter, involving the chiasma and beginning of the right optic nerve. The nerve was split longitudinally and some white necrotic material removed from its substance (fig. 16); 100 mg. of streptomycin was left at the operation site. The patient was discharged 18 days after the operation.

On March 4, 1955, vision was: R.E., 6/60; L.E., no perception of light. Perime-

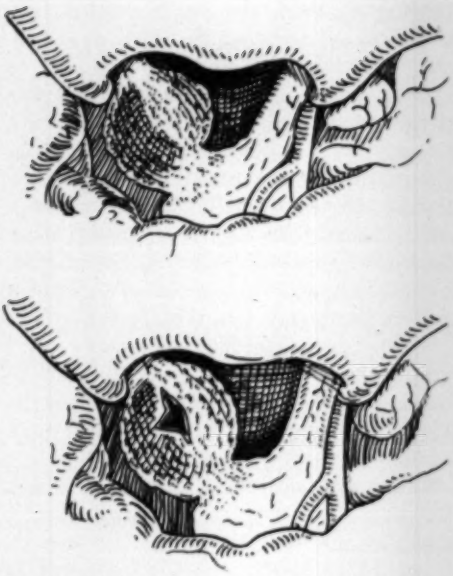

Fig. 16 (Mooney). *Case 12.* Findings at operation.

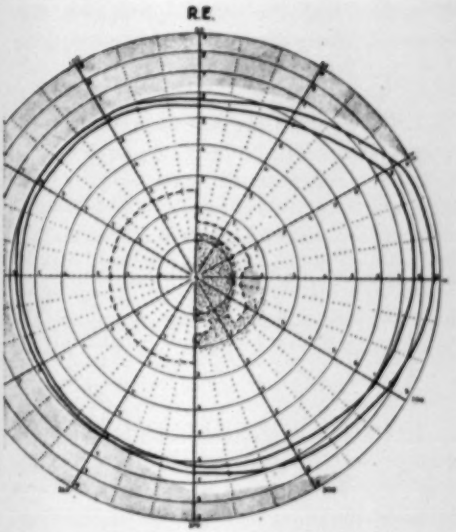


Fig. 17 (Mooney). *Case 12.* March 4, 1955. Vision: R.E., 6/60; L.E., nil. R.E., grade-2 pallor of disc with clear margin; L.E., grade-3 pallor of disc with clear margins. Test objects: 3/330 and 1/330.

try showed (fig. 17), right eye, full fields for 3/330-1/330, white. Temporal hemianopic scotoma breaking through for 2/2,000 white.

*Comment.* The findings in this case were suggestive of tuberculous granulation tissue with caseation inside the left optic nerve and chiasm. The recovery in the right visual field was spectacular.

CASE 31

C. McG., aged 15 years, was 14 days ill before admission to hospital on May 4, 1954. The diagnosis of tuberculous meningitis was made. On May 8, 1954, the pupils reacted very sluggishly to light and the vision in each eye was practically nil. The discs were normal and no chorioidal tubercles were seen.

On May 16, 1954, the fundi were unchanged and the vision was nil. Intrathecal streptomycin was stopped and a course of cortisone started. As there was no improvement in the vision after seven days, the cortisone was discontinued and systemic chloromycetin begun.

On June 13, 1954, there was no improvement in vision and, while the right disc was a good color the left was slightly pale. There was right internal rectus palsy and left-sided ptosis. Chloromycetin was stopped and intrathecal streptomycin resumed. Neurosurgery was advised.

On July 22, 1954, right frontal craniotomy was performed. Numerous fine adhesions which appeared to radiate from the pituitary fossa across both optic nerves and the chiasma were easily removed. The operation was completed by performing an anterior third ventricle short circuit through the lamina terminalis. The patient was discharged on the eighth postoperative day, having withstood the operation well.

On March 5, 1955, there was grade-3 pallor of the discs with no return of vision. The patient was otherwise well and was being rehabilitated.

*Comment.* Comparing this case with the previous ones and having regard to the poor postoperative visual result, one would have

to assume that the original condition was retrobulbar neuritis as well as arachnoiditis.

CASE 42

D. D., aged 10 years, was eight days ill before admission to hospital on May 19, 1952. The diagnosis of tuberculous meningitis was made. On April 18, 1954, fundus examination showed grade-2 pallor of the discs with clear margins and normal vessels. Vision was: R.E., no perception of light; L.E., counts fingers at two meters in the nasal field. There was also bilateral partial third-nerve palsy. Neurosurgery was advised.

On May 11, 1954, right frontal craniotomy was performed. Exposure of the chiasma was difficult because of numerous adhesions between the dura and arachnoid over the frontal pole. The right optic nerve and chiasma were exposed with extreme difficulty and cleared of adhesions. It was found impossible to clear the left optic nerve as no plane of cleavage could be found, but the adhesions on either side of the nerve were cut so as to lessen the tension. Some caseous material was removed from the pituitary fossa and the operation was completed by doing an anterior third ventricle short-circuit.

The boy was discharged on the eighth postoperative day, in good condition. When last seen on March 13, 1955, there was grade-3 pallor of each disc. Vision was: R.E., no perception of light; L.E., counts fingers at two meters in the nasal field. He is being rehabilitated.

*Comment.* The absence of any visual improvement in this patient may be attributable to the length of time that elapsed between the onset of the disease, two years previously, and the operation.

CASE 28

S. S., aged two years and nine months was admitted to the hospital on January 6, 1954, having been ill for three weeks. The diagnosis of tuberculous meningitis was made. On January 8, 1954, the pupils reacted very sluggishly to light and the fundi were normal. The child was blind.

On January 22nd, no improvement was noted and transfer to the neurosurgical unit was advised. On January 28th, right frontal craniotomy was performed, retraction of the frontal lobe being facilitated by tapping a dilated lateral ventricle. Numerous soft adhesions were removed from both optic nerves and chiasma which then appeared very rough and inflamed (fig. 18). The operation was completed by performing an anterior third ventricle short-circuit through the lamina terminalis. The child was discharged on the 15th postoperative day, having suffered no ill effects.

There was no material recovery of vision for over two months, but after that it gradually improved and when last seen on March 13, 1955, she appeared to have perfect sight and the fundi were normal.

*Comment.* I have referred to this as a case

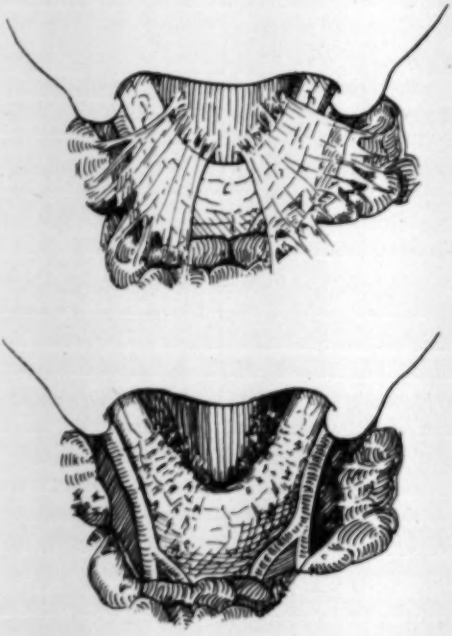

Fig. 18 (Mooney). *Case 28.* Findings at operation.

of retrobulbar neuritis but it is possible that it falls into the same category as the other cases that were operated on for pale discs. The pathology found at operation was similar, but the operation was performed earlier before pallor of the discs had time to develop.

## Discussion

As mentioned at the beginning of this paper, the object of the present investigation is to find the cause of these eye complications and either to prevent or treat it. The pathologic process appears to be tuberculous arachnoiditis which causes either papilledema by interfering with the circulation of the cerebrospinal fluid or pale discs by strangulating the pial vessels going to the optic nerves and chiasma.

Study of the statistics fails to establish any connection between the amount of intrathecal streptomycin and these eye manifestations. Moreover, they develop early in the course of the disease which is the opposite to what one would expect if they were related to the amount of streptomycin given intrathecally. Incidentally there does not appear to be any relationship between the deafness and the eye complications.

The necessity for neurosurgery seems to be influenced to a certain extent by the length of time the patients are ill before they get treatment.

If this assumption is correct, a recommendation should be made that, when a general medical practitioner is in doubt about diagnosis in a case of this nature, the patient should be sent immediately to a suitable hospital for treatment.

A short course of cortisone, in the absence of serious pulmonary complications, should be started and continued for about three weeks, with a view to preventing the formation of adhesions. A long course does not appear to me to be justified because the eye complications usually appear within the first few weeks.

Having failed to prevent papilledema or pale discs, a careful watch should be kept on the discs and, if the fundus condition should deteriorate in spite of treatment, my feeling is that neurosurgery is justified unless contraindicated by the patient's low physical state. These patients appear to stand neurosurgery very well and, to my mind, the small risk is justified if, by taking it, the patient's sight may be saved. Incidentally I am not quite sure that a dilated third ventricle by pressing on the blood supply of the chiasma may not be an additional cause of defective vision in these cases, as some degrees of hydrocephalus was found at operation in the majority of cases.

I have been unable to give records of the patients' vision either before or after operation in many cases, mainly due to their ages but also to the fact that many were ill and unco-operative.

For those who wish to study statistics I have drawn up tables which cover most of the relevant points. In some cases there was difficulty in getting certain information such as the length of time they were ill before admission, and, if they were treated elsewhere before admission, how much of the various drugs they were given in that institution. There are, however, sufficient details in the tables to give a good general picture of the relevant factors that might influence the development of eye complications.

I would not like you to regard this paper as a final assessment but my impression is that much can be learned from these 65 patients, many of whom are still in hospital. Perhaps, in the next year or two, more satisfactory prophylactic and curative results will be obtained as the investigation continues.

## Summary

We have in the eye complications of tuberculous meningitis a comparatively new problem. Taking the short view, it is likely to become more frequent.

An effort has been made to determine the cause of these complications and also to

evolve a satisfactory form of treatment should they develop.

Where treatment fails to save the patients' vision, rehabilitation is instituted while they are still in hospital.

Finally, I cannot conclude without paying a tribute to the remarkable results obtained in the treatment of tuberculous meningitis during the period under review. A survival rate of over 80 percent is a distinct achievement and during the current year the results are better still.

*33, Fitzwilliam Place.*

I am indebted to Dr. F. O'Herlihy and Dr. O'Connor of Dublin Fever Hospital, Dr. F. Elcock of Clonskeagh Fever Hospital, and Dr. Duffy and Dr. Ryan of Rialto Hospital, for giving me the opportunity of examining these patients and also for their generous assistance throughout the investigation. I wish to thank Stella Ross for the operation drawings.

## HETEROCHROMIC CYCLITIS IN IDENTICAL TWINS*

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In a recent article on heterochromic cyclitis in THE AMERICAN JOURNAL OF OPHTHALMOLOGY.[1] Dr. Franceschetti ended by saying "if one day we have the good fortune to find identical twins with Fuchs' syndrome, we hope it will be easier to answer the difficult question of the role of the genetic factor in complicated heterochromia." The following is a report of heterochromic cyclitis in identical twins.

### CASE REPORT

One year ago Mrs. M. G., 43 years of age, requested consultation because of failing vision in the right eye. She first began having trouble with her eyes six years ago when bright light caused considerable glare and dazzling. Two years previously she had been seen by an ophthalmologist who told her a cataract was forming on the right eye but no treatment was offered.

The patient came from a family of nine children and was herself a twin. The mother and father and other brothers and sisters had never had any eye trouble but her twin sister was having difficulty with her left eye. Excepting some rheumatism in her right arm and early menopausal symptoms, Mrs. G. had enjoyed good health all her life.

On examination Mrs. G.'s visual acuity was: O.D., counting fingers; O.S., 20/20, J1. Glasses made no significant change in the visual acuity. On slitlamp examination the right eye showed many fine and moderately large translucent keratic precipitates occupying the lower one half of the posterior surface of the cornea.

The anterior chamber was clear with no evidence of a flare. There was considerable atrophy of the iris stroma especially temporally and in the pupillary zone. The iris pigment epithelium appeared moth eaten and was entirely absent in places along the margin of the pupil. The iris color was blue gray and somewhat lighter than the left eye. There were no posterior synechias. Dense feathery posterior polar opacities were noted in the lens and these spread out in all directions.

The left eye showed no abnormalities. The iris was blue gray in color and the lens was clear.

The fundus of the right eye was somewhat obscured by the lens opacities but the disc appeared normal with a fairly large central cup. No areas of chorioretinitis were noted. The left fundus was normal. The

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Fig. 1 (Makley). Mrs. E. B. (left) O.S. affected. Mrs. M. G. (right), O.D. affected.

right pupil dilated with cocaine but not as widely as the left pupil. Homatropine dilated both pupils equally. The intraocular pressure was: O.D., 23 mm. Hg; O.S., 23 mm. Hg (Schiøtz).

The patient was hospitalized for a complete uveitis survey. General physical and neurologic examinations were negative. The arm length was 62 inches and her height was 61 inches. The patient was skin tested to the common bacterials and found sensitive to histoplasmin 1/1,000 and O.T. 1/1,000. A course of streptomycin and isonicotinic acid hydrazide, desensitization to O.T., and hydrocortone and atropine locally were not effective. After about one month, the true nature of the disease was recognized and treatment was quietly stopped.

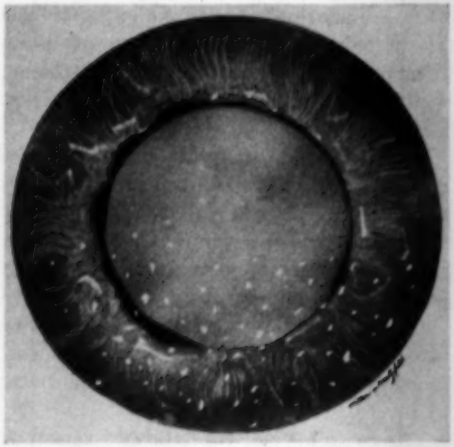

Fig. 2 (Makley). Right eye of Mrs. M. G. Note the loss of pigment epithelium along the pupillary margin from the 4- to 6-o'clock positions and the atrophy of the pupillary zone from the 6:30- to 12:00-o'clock positions.

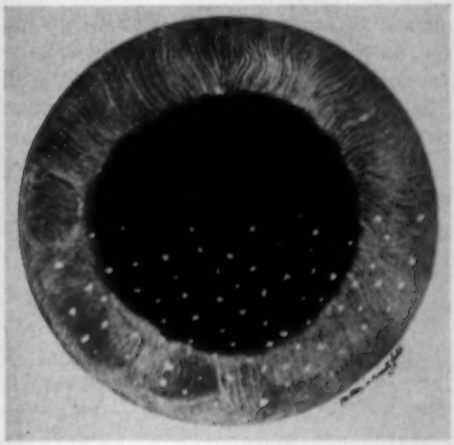

Fig. 3 (Makley). The left eye of Mrs. E. B. The iris atrophy is noticed first in the pupillary zone.

**M.G.**

**TYPE O**
**Rh NEGATIVE**

***REMARKS***

**C-D-E-C+e+KELL-**
**DUFFY+M-N+P-S-**

**E.B.**

**TYPE O**
**Rh NEGATIVE**

***REMARKS***

**C-D-E-C+e+KELL-**
**DUFFY+M-N+P-S-**

Fig. 4 (Makley). The blood groupings and analysis of the hand prints have established the twins as monozygotic.

During the year she was followed, the right lens became completely opaque and was extracted on September 11, 1955. A peripheral iridectomy was performed and the piece of iris was submitted for study. The pathologic report follows:

*Microscopic:* The cytoplasm and even the nucleus in many of the cells are vacuolated. This is also true of the fibers of the sphincter muscle. The anterior border is quite cellular but no pigment is noted in this area. The blood vessels are more numerous than usual and instead of having thick walls associated with normal iris vessels the walls are unusually thin and irregular. They seem in places to be even fragmented. The pigment in the iris epithelium is loosely arranged and appears in the first stages of degeneration. It should be stated that the iridectomy was done in the most normal looking part of the iris as seen with the slitlamp biomicroscope.

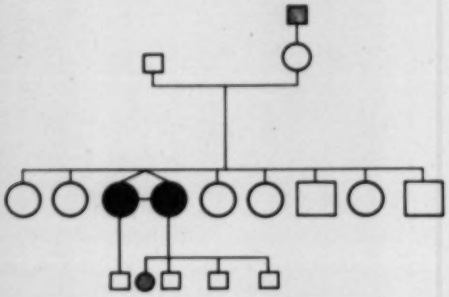

Fig. 5 (Makley). The family tree.

Mrs. E. B. was seen several months after Mrs. G. and with much the same complaints affecting the left eye. Her general health had always been good.

On examination her visual acuity was: O.D., 20/20; O.S., 20/200. The vision in the left eye could not be improved with glasses. Slitlamp examination revealed the right eye to have a normal anterior segment. The iris was blue gray in color and dilated well with cocaine. On the posterior surface of the cornea of the left eye were many fine and moderately large translucent keratic precipitates. There also was a faint brown line running in the deeper stroma just below the center. The iris was blue gray, very slightly paler than the right eye. There were no flare and no posterior synechias. The pupillary zone of the iris was atrophic but not nearly as advanced as in her twin. There were granular opacities in the posterior pole of the lens which radiated out in all directions toward the periphery. The pupil dilated well with cocaine but not quite as widely as O.D.

Fundus examination was normal in the right eye and, while the fundus was somewhat obscured by the lens opacities, no abnormalities could be seen in the left eye. The intraocular pressure was: O.D., 20 mm. Hg; O.S., 20 mm. Hg (Schiøtz).

General, physical, and neurologic examinations did not reveal anything significant. Her arm span was 62 inches, her height was 61 inches.

The twins have been established as monozygotic, not only by their strikingly similar appearance and characteristics but also by an analysis of their hand prints and by their identical blood groupings.

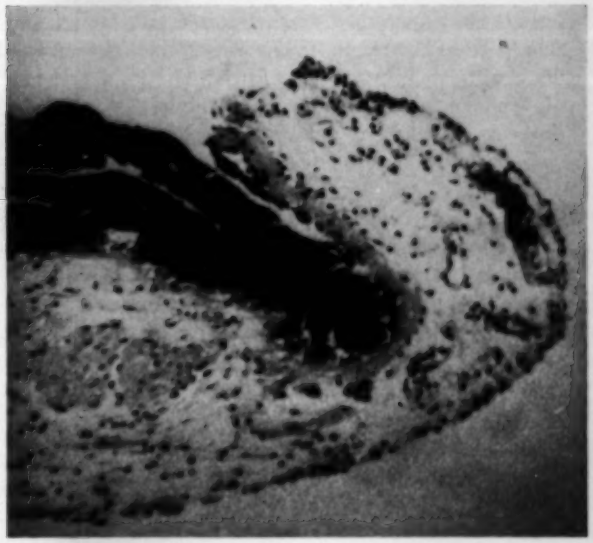

Fig. 6 (Makley). Photomicrograph of the iris removed at time of cataract extraction on Mrs. M. G. The vessels are thin walled; very few inflammatory cells are seen; and chromatophores are absent.

### Family history

The parents came from Luzern in the southern part of Switzerland, entering this country when the twins were three years old. They have been examined and, excepting senile changes, there were no ocular abnormalities. Both had blue gray irises but no heterochromia. The blue gray iris with minor variations predominated in the two brothers and five sisters. In some a few pigment freckles were present. In the youngest girl, there was a light yellow frill in the pupillary zone of each iris but no evidence of heterochromia irides. The children of the twins were examined and there was a slight suggestion of color difference in the irises of the oldest child, a daughter of Mrs. B. The maternal grandfather had some difficulty with his eyes and apparently was the object of much curiosity when entering the United States, because the immigration authorities held him up for this.

### Comment

Heterochromic cyclitis is a very interesting entity which becomes more intriguing the more one sees of it. Little has appeared in the English literature on this subject until recently[1, 2] and these articles stress its common occurrence so much that they should make one remember to compare the color of both eyes in all cases of low-grade iridocyclitis with keratic precipitates. In spite of the fact that the condition has been described for over a hundred years, we are still far away from an understanding of it. How does its mechanism differ from that of ordinary iridocyclitis? Why are there keratic precipitates, complicated cataract, and iris atrophy and yet no posterior synechias and little or no evidence of inflammation, and why are these complications so late in coming?

Theories have been proposed but none proven. There are those who feel it is a low-grade inflammatory reaction but against this are the several cases studied histologically which show no evidence of inflammation but only atrophic changes.[3] Others feel there is a sympathetic disturbance and that there must be some relationship between the neurogenic heterochromia and the heterochromia with cyclitis.[4, 5] The sympathetic disturbance, whatever it may be, leads to changes in the blood vessels and atrophy of the iris stroma and chromatophores.

Amsler[6] has shown that after paracentesis of the anterior chamber in heterochromia of Fuchs a filiform hemorrhage occurs which is pathognomonic. Certainly the vessels in the present case (M. G.) do not appear healthy and this may be the underlying reason for the hemorrhage. This does not occur in neurogenic heterochromia and is an argument against an intimate relation between the two.

In Amsler's series though, one case which developed a hemorrhage did have Horner's syndrome associated with the heterochromic cyclitis. Six other cases associated with Horner's syndrome did not bleed. Perhaps the cases of neurogenic heterochromia had not progressed far enough to have developed the certain vascular fragility necessary for the bleeding. There have been several cases reported in which Horner's syndrome has not only been accompanied by a decoloration of the iris but the formation of corneal precipitates.[7]

Finally the genetic factor[8] has also been suggested but observations concerning the familial appearance of the syndrome of Fuchs have been extremely rare: Fuchs found this condition in a mother and daughter. Kranz found it in three members of a family and Streiff found a simple heterochromia and a case of heterochromic cyclitis in the same family. Franceschetti also reported cases of heterochromic cyclitis in a brother and sister. This is the first report of heterochromic cyclitis in identical twins.

Does this finding answer any questions? One can say that, in these twins, the affection must have been congenital. Whether hereditary in nature or due to a toxin that was active during the mother's pregnancy would be difficult to prove, since no other members of the family are definitely affected.

## Summary

The unusual finding of heterochromic cyclitis in identical twins is presented. The histologic changes in a piece of iris removed at cataract extraction are reported. A study of the immediate family reveals no other definite cases in four generations. Theories of causation are briefly discussed.

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I would like to express my appreciation to Prof. David C. Rife, Director of the Genetic Institute at Ohio State University, for his help in establishing the twins as monozygotic. The help of the Medical Arts Departments in preparing the illustrations is also gratefully acknowledged.

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# CLINICAL TEARS IN THE RETINA WITHOUT DETACHMENT*

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The evolution of present-day treatment for idiopathic retinal detachment has followed the same course as that of many other disease entities—that is, from its discovery to an understanding of its cause, a rational form of treatment, and finally an attempt at its prevention.

In the opinion of many, the first man to report an anatomic description of a retinal detachment was de Saint-Yves,[1] who, in 1722, referred to it as amotio sine sublatio retinae; more than a century (1839) later the clinical observance of a retinal detachment through a dilated pupil was noted by von Chelius.[2] Following Helmholtz's public introduction of the ophthalmoscope in Koenigsberg in 1851, clinical description of retinal detachment and the presence of tears in the retina were written by Coccius[3] (1853) and by von Graefe[4] (1854); interestingly enough, the latter regarded the tear as part of the healing process and endeavored to cure the detachment by producing other tears so that the retina would settle more readily. It remained for de Wecker,[5] in 1870, to suggest that the tear was the cause of retinal detachment, not a consequence of it, and for Leber[6, 7] to introduce the vitreous-traction theory when he conceived the idea that rupture of the retina was an essential feature in detachment in 1882. These concepts were supported by the anatomic researches of Nordenson,[8, 9] in 1885 and 1887, and enlarged upon by Gonin[10, 11] in 1904.

The earliest operation for the treatment of retinal detachment was a simple puncture of the sclera at the site of the detachment; possibly the first to perform this was Ware[12] in 1804, but it was much more widely offered by Sichel[13] who described it in 1859.

The scores of operative techniques employed by ophthalmologists since that time in an attempt to cure retinal detachment were, from the vantage point of reflection, both imaginative and fruitless. Schoeler,[14] in 1889, is credited as being the first to choose the region of the retinal tear as the operative site, injecting tincture of iodine in the preretinal space between the vitreous and retina in the neighborhood of the tear. During the same year Deutschmann[15] reported using ignipuncture at the site of the tear; his theories of the etiology of retinal detachment and the significance of the retinal tear, however, precluded his pursuit of this form of therapy.

Galezowski[16, 17] most probably should be recognized as the first to utilize systematic ignipuncture to close the tear, reporting on cases in 1902 and in 1903; unfortunately, he died shortly thereafter and his procedure remained largely unnoticed.

The present century was thus bequeathed a few truths and an excess of misconceptions regarding detachments of the retina; it was largely through the continued efforts of Jules Gonin, a Swiss ophthalmologist, that the several pertinent factors involved were repeatedly emphasized and co-ordinated to form a rational treatment.

Gonin[18–21] first reported some "unexpected successes" at Bale in 1919, and then more "with, of course, great reserve" in 1921, 1923, and again at Zurich and Heidelberg in 1925 and 1926. It was not until the International Congress in Amsterdam in 1929 that his works became generally known to the English-speaking ophthalmologists and, by 1930, he was able to report results on about 250 patients, saying that 60 percent of cures of recent cases should be obtained.

At least a few men were aware of Gonin's work as early as 1921, for Killick,[22] in discussing idiopathic detachment of the retina, referred to Gonin's theory; he cited 85 authenticated cases of cures collected by the

* Presented before the Pacific Coast Oto-Ophthalmological Society, Portland, Oregon, May, 1955.

Ophthalmological Society in 1915-16, among whom were 51 myopes. Killick felt that there was "no rational method" of cure at the time, and that the question ". . . is largely one of prophylaxis. How to maintain the ciliary body and uveal tract in their highest state of efficiency is a problem that must be solved if we wish to guard any predisposed patient against the awful calamity of idiopathic detachment."

Lindner,[23] in 1934, theorized on the prevention of detachment, and said that some day an operation for prevention of retinal detachment when detachment is imminent might be developed.

To date, prophylaxis has been confined to the early detection of retinal detachment and to the search for and discovery of early breaks and degenerative foci in the still attached retina. Paradoxically, the problem of a retinal tear without detachment may be more perplexing than that of a frank retinal detachment.

In an examination of 37 myopic eyes histologically, Hanssen[24] found that, in 26, there were partial thinning of the retina, cystoid degeneration, some slight tears in the inner retinal layers, and direct holes; in none of the cases was there a detachment of the retina. He believed that the tear was the most necessary factor for the development of a retinal detachment, but that degenerative changes in the vitreous and reduced intraocular pressure must also be present.

Teng and Katzin,[25, 26] in two excellent papers, have summarized the findings in 167 normal human eyes, describing granular patches, floaters, and holes in the periphery of the retina. In three of the cases there were operculated holes and in one case there was a hole that had become organized. They found that anatomically it was difficult to differentiate small cysts of the pars plana, dilated cysts due to peripheral cystoid degeneration, and small degenerated areas of the retina from real holes in the retina; clinically the difficulty should be even greater. They are of the opinion that the motility of accommodation is the important and causative factor in cystoid degeneration, and that vitreous adhesions to the delicate cystic wall, in addition to senile liquefaction of the vitreous, predispose the eye so that minor trauma may precipitate a tear; perforation of both the inner and external walls of the cyst is then necessary for the creation of a retinal tear, leading to detachment.

Minsky[27] also wrote regarding the attachment of the hyaloid to the retina and of the possibility of tears being produced with accommodation and ciliary muscle spasm.

Fahmy[28] felt that actual contraction of choroidal patches was the essential feature in the production of the tear, first in the outer retinal layers, then the pull of the vitreous completing it; to emphasize this point he mentions the occasional tear occurring at the edge of a well-cauterized retinal area in the treatment of retinal detachment: "The patch, which at first was white and raised, becomes pigmented and flat, and after six months a tear is seen at the edge. This is certainly due to contraction of the old focus of artificially produced inflammation."

Histologic examination of eyes with retinal detachment by Lindner[29] showed the detached virteous adherent to the peripheral margin of the retinal tear with communication between the subvitreal space and the subretinal space.

In a review of the literature on the pathogenesis of retinal tears, Joannides[30] comments on two patients who developed detachments of the retina within two and three months following an extensive posterior detachment of the vitreous; he concludes that in the majority of cases of retinal tears their formation is due to the movements of the detached vitreous body.

There have been numerous clinical reports of the discovery of tears in the retina without an associated detachment of the retina.[30-61] Gonin[34, 36, 62] mentioned several times the occurrence of such tears, and in 1934 he presented three cases, one of which was followed for three years without

detachment. In referring to Hanssen's work which demonstrated holes in the peripheral retina in myopia, Gonin[34] said that, if the vitreous body were normal, it would act like a cork in front of the opening of the retina, but that, if the vitreous were detached and a certain amount of fluid had collected between its mass and the retina, the fluid could make its way through the hole and produce the detachment.

Arruga[42, 63] stated that a healthy retina never becomes detached, even if it tears, and published drawings of two cases in which the tear was surrounded by pigmentation, indicating a healed inflammatory process, and a circular hole with a freely suspended operculum.

Lindner[64] noted that tears without detachment occurred, and believed that annular adhesions between the choroid and retina prevented their separation.

Knapp[50] presented five cases with tears, only one of which went on to detachment six months later; the remaining four cases did not detach, over periods ranging from three months to seven years. He cited several cases in the literature illustrating the thesis of the prevention of detachment by formation of chorioretinal adhesions, but was inclined to think that this alone was not the determining factor, inasmuch as three of his cases showed no choroidal changes. Knapp concluded that the detachment did not occur in his cases due to the lack of access to the subvitreous fluid, or that in the presence of attached vitreous there was no tear in the hyaloid membrane to permit escape of fluid from the vitreous, suggesting the "corklike" action referred to by Gonin.

Knapp urged careful observation of such cases, concurring with Vogt,[37] who earlier had reported on three cases of retinal tear in the lower retina; these three cases did eventually detach, one of them three to four years later. Vogt also mentioned two cases with tears in which the "lid" became detached, floating freely in the vitreous.

More recently Monami and Heintz[53] reported two cases of retinal disinsertions which were followed without operation, nonintervention being more desirable because of spontaneous scarring and intact visual functions.

Somewhat similar cases were described by Gradle and Sugar,[65] who summarized nine cases of self-limited detachments of the retina, and commented upon the appearance of demarcation stripes and retinal striae. Safar[66] has reported on several cases, concluding that there is no absolute indication for prophylactic operation in cases of latent tears of the retina.

The majority of authors appear to be in favor of prophylactic operations when tears of the retina are discovered. Sabbadini[40, 67] discussed prophylactic operation in 1935 and advised it in the event that no tendency to heal could be seen; more recently he has again urged similar treatment, extending it to cases in which lesions are present that are likely to develop into tears. He particularly feels that operation should be performed when there has been a detachment in the fellow eye. He uses surface diathermy according to Weve's technique, keeping the current strength low (he mentions 80-90 ma., which appears to be a rather high reading; the milliamperage reading varies considerably, however, from one machine to another, and also from one locale to another in the same city).

Amsler[68] felt that surface diathermy should be employed when there was an obvious tear of the retina with no healing tendencies, as did Sobhy Bey,[47] and Jess,[48] the latter also advocating its use if the retina showed only a suspicion of tear in a patient with a detachment in the other eye.

Jess had operated seven cases prophylactically with success, and emphasized a very careful examination. It is pertinent that Amsler[69] had already mentioned that detached vitreous was frequently a prodromal sign of detachment of the retina, and that Vogt[70] had pointed out that pressure over the ora serrata would occasionally reveal a hidden

tear; the future assistance of the slitlamp in the clarification of the problem was accurately foreseen by Lister[71] when he commented on opthalmoscopically visible vitreous attached to the flaps of retinal tears.

Granstrom[49] presented a case of tear without detachment which was followed for over a year only to detach several weeks after she struck her head on a door; he included an extensive review of the literature and concluded that he should have preformed a prophylactic operation. In the absence of distinct signs of healing in the form of chorioretinitis Granstrom urges a prophylactic operation according to the method of Larsson. Fleischer[51] reported on 18 patients on whom he operated for preventive reasons; in 12 of the cases there was a previous or simultaneous detachment of the retina in the other eye. He recommended surgery with the view in mind that it was easier to cure a hole than a detachment.

Linde[52] also is in favor of early surgery, and refers to a case of Marfan's disease in which the eye was lost with a detachment following cataract extraction; he performed prophylactic coagulation on the second eye, over the temporal part of the globe, before performing a successful cataract extraction.

Franceschetti[61] is of the same accord, and cauterized the sclera in the region of the retinal degeneration if the other eye has a detachment. He states that he does not operate the cataract in the second eye if the first eye has had a nontraumatic detachment without first doing a prophylactic barrage of the upper two quadrants.

Posner[55] described a spontaneous cure in a young myopic woman with a tear in the extreme periphery at the 6-o'clock position; after four weeks of bedrest the surrounding retinal edema had disappeared and there were pigmentary changes in the adjacent retina; he goes on to say that if the other eye has suffered a detachment, or if the affected eye is the only useful eye, the sclera should be coagulated by surface diathermy.

Graupner[56] presented a case in which preventive surgery was utilized, resulting in a cure; in the discussion, von Sallmann remarked that he felt that the inflammation causing the vitreous-retinal adhesions probably also causes a minimal chorioretinal adhesion, and that although it was not seen in this case, nor in those described Knapp, it might be seen histologically, as earlier described by Gonin. In the same discussion, Perera[56,72] advised surface diathermy, and later re-emphasized this stand, believing that there should be 100 percent good visual results in tear without detachment.

Arruga[58] discusses the point in reference to patients with very early suggestive changes, and guides himself by two factors, namely the change in the lesion as seen ophthalmoscopically and by reference to drawings of the lesion, and by the observation of photopsia by the patient. He applies very light diathermy, in such a way that the retina is not coagulated and no ophthalmoscopic changes are visible at the time; he reports having applied this technique in more than 40 cases without any complications. Initially the foci appear a little opalescent, but soon pigment appears and a spot of chorioretinitis remains. In the discussion following, Talavero preferred nonpenetrating scleral resection rather than diathermy in myopic eyes with staphylomatous scleral zones where "predetachment" lesions are discovered.

Csapody[73] is inclined toward operating tears and degenerated areas of the retina before detachment occurs, commenting that early operation is safer than operation for detachment.

Schepens[59] writes of subclinical detachments of the retina in 110 eyes of 102 patients; a clinical detachment was present in the other eye in 57 instances; only 43 of the patients had visual complaints of any sort, a variable degree of vitreous hemorrhage being present in 13 patients. He found that 76 percent of the retinal tears (with flap or operculum) were near the equator, while 69 percent of the retinal holes were near the ora serrata; 12 of the 13 cases with

vitreous hemorrhage were associated with retinal tears and were operated upon, from clinical evidence that vitreous hemorrhage indicates a rapid shrinkage of the vitreous. In all, 39 patients had prophylactic procedures performed; in one case there was no light perception following surgery, and this case he now believes to be one of early multiple sclerosis; in one other case there was a clinical detachment which occurred three months following the operation; the patient was reoperated, but developed a massive vitreous retraction. Schepens places weight upon the presence of vitreous hemorrhage, localized photopsia, the status of the other eye, and the number, size, and location of the breaks in the retina, the indications being stronger when the breaks are either large or numerous, or when they are at the equator rather than near the ora serrata.

## Presentation of cases

The following 26 cases were all seen as private patients, and are described in an effort to ascertain which factors are of value in determining whether or not a prophylactic operation should be performed when a retinal tear without an associated detachment of the retina is found. In addition, four other cases (A to D) are presented to illustrate several pertinent findings.

When a patient complains of a sudden appearance of "specks," "soot," "flashes of light," and some decrease in vision, the ophthalmologist should not be wholly unprepared to see a detachment of the retina when he examines the fundus. Quite frequently, however, there is no detachment evident, and a vitreous detachment is found.

A detachment of the vitreous is a common occurrence in many normal patients of middle age; often with the slitlamp and Hruby lens the vitreous body can be seen to be intact in the eye with no symptoms and to be collapsed in the eye with the symptoms, when the latter has previously been observed to be normal during a former refraction. This explanation for the symptoms should be made only after thoroughly excluding the possibility of a fresh retinal tear which has not yet led to a perceptible separation of the retina.

This type of patient should be examined again at frequent intervals and care taken to dilate the pupil well for each examination; such perseverance on the part of the ophthalmologist (and the patient) will occasionally allow the discovery of an actual tear not previously seen, or afford the opportunity to watch the development of a tear.

Examination of the following patients was done with both indirect and direct ophthalmoscopy, aided in the majority of instances by use of the Bausch and Lomb binocular ophthalmoscope and the Goldmann slitlamp with the Hruby lens attachment.

### Case 1

A 65-year-old white man was seen February 24, 1947, with a history of "whirling, different-shaped brownish areas in front of the right eye" for three days; he remembered bumping his head on getting out of a car 11 days previously.

Vision in the right eye, which had been 20/15 on previous refractions, was decreased to 20/25. Vision in the left eye was 20/20. Visual fields were normal in both eyes.

In the right eye was a retinal tear at the equator in the 9-o'clock meridian; there was a floating vitreous opacity just in front of the tear but, because of vitreous opacities from the hemorrhage, a definite detachment of the vitreous could not be seen. There was no elevation of the surrounding retina.

The patient was placed on stenopeic glasses and rest at home. He was seen at frequent intervals and, by March 6th, vision with glasses was 20/20. Two small hemorrhages adjacent to the tear in the retina which had been present on the first examination had absorbed; a week later the tear was becoming quite pigmented and more difficult to make out.

By mid-April there was still more pigmentation and the vitreous opacity could still be seen easily; he had discarded the stenopeic glasses a month previously. When last seen on May 16, 1955, over eight years after onset of symptoms, vision was 20/20 and the pigmentation about the hole was quite obvious. He now had an obvious collapse and detachment of the vitreous; the opacity was still floating freely.

### Case 2

A 63-year-old Italian storekeeper seen May 19, 1947, complaining of "a cloud or cobweb" in the upper temporal field of the left eye for the previous week. Previous refractions had revealed vision of 20/20 in the right eye and 20/200 in the left eye

(amblyopia since childhood). Central vision was unchanged, and visual fields normal.

In the left eye, temporal to the macula, was an area of healed choroiditis in front of which was a floating vitreous opacity, which always stayed in the same region. The area of healed choroiditis was in the center of an almost round tear in the retina, the central edge of which showed a fresh hemorrhage. The temporal edge of the tear was definitely turned into the vitreous. Two days later the superior and temporal edge of the tear seemed definitely elevated, but there was no change during the following week.

The patient failed to return and was not seen until November, 1950, at which time vision was unchanged and the healed choroidal focus could be seen easily. There was no suggestion of a lip to the tear; in front of the area the typical disclike opacity was still floating in the vitreous. He was last seen on October 21, 1954, seven and a half years after his initial complaint, at which time there was no change.

CASE 3

A 65-year-old white housewife seen October 7, 1947, because of poor vision in the right eye for the previous few days. Vision and examination of the left eye were normal. Vision in the right eye was decreased to counting fingers at two meters because of a marked vitreous hemorrhage, which appeared to stream from temporal and above to nasal and below. Temporal and above was a definite tear in the retina, with a blood vessel attached to a vitreous opacity floating in front of the tear. The visual field was intact.

She was placed on stenopeic glasses and seen frequently in the office; the vitreous opacities decreased and vision improved to 20/40. Glasses were removed on November 4th; on November 10th she had another vitreous hemorrhage which lowered vision to counting fingers at one and one-half meters and obscured the retina. When she was placed back on stenopeic glasses, the vitreous again slowly cleared so that, by January 23, 1948, she could see better than 20/30.

The patient was not amenable to surgery and continued to wear her stenopeic glasses. By August, 1948, there was a definite round hole in the retina, the edges of which were only slightly elevated and grayish, but there was no elevation of the retina and still no sign of pigmentation around the hole. She kept the stenopeic glasses on out of doors but removed them indoors.

In June, 1949, there was a small hemorrhage central to the area of the hole but the hole could not be made out definitely. In February, 1950, there was some increased pigment in the region of the tear.

When last seen October 21, 1954, seven years after her first visit, the vision in the right eye was 20/20 and there was no sign of the former hole. There was a detachment of the vitreous in the upper temporal quadrant, and on the posterior surface of the vitreous in this region was an opacity. There was at this time a viterous detachment with collapse in the upper temporal quadrant of the left eye.

CASE 4

A 66-year-old white woman was seen February 28, 1949, with the complaint of "floating objects" before the left eye for several days. Vision was 20/20 in the right eye, and 20/20— in the left eye; visual fields were normal.

In the left eye were many large vitreous opacities horizontally distributed, and a fine vitreous haze; the retina was attached.

She was treated with rest as a vitreous hemorrhage patient and, by March 11th, a detachment of the vitreous in the posterior quadrant could be seen. At this time, an oval gray opacity could be seen floating in the vitreous just in front of the retina, temporally in the periphery; the opacity moved about in a limited area. Just behind and peripheral to the opacity, a small hole in the retina could now be made out, with questionable elevation of the rim of the tear; this tear could be seen more easily with the indirect ophthalmoscope than with the direct.

She continued to wear stenopeic glasses and, by March 31th, pigmentation was beginning to appear almost everywhere around the rim of the tear. No retinal detachment developed and, when she was last seen for refraction, May 16, 1955, the tear was indistinct with pigment about it; the vitreous opacity could still be seen. Vision was 20/20—, six years after the onset of the tear.

CASE 5

A 49-year-old white woman was seen in consultation on April 4, 1951. She had suffered a vitreous hemorrhage in the right eye in December, 1950, which slowly cleared; there was now a question of a tear in the retina.

Vision in the right eye with a —6.25D. sph. was 20/30—; vision in the left eye was 20/40 with a —5.75D. sph. Examination of the left eye was not remarkable except for a faintly visible posterior detachment of the vitreous.

The right eye had a marked detachment of the vitreous with collapse and an annular opacity floating in the vitreous. Temporally there was another almost spheric opacity in the vitreous; behind this and further in the periphery was an oval area in the retina with a grayish border which looked like the torn edge of retina.

Two weeks later, using the binocular direct ophthalmoscope, the suspicious area could be still seen, and it appeared as a hole with the edges rolled inward to the vitreous; no definite elevation of the retina could be discerned; with the Goldmann slit-lamp and the Hruby lens the collapse of the vitreous was easily visible, with the opacity on its posterior surface.

The patient was followed closely by her referring doctor, whose last report on June 1, 1954, was that no detachment of the retina had occurred; this was just over three years since she was first seen.

CASE 6

A 55-year-old white man was first seen November 27, 1951, with a history of "blurry vision" in the left eye of 10 days' duration; the vision cleared up after lying down.

Vision in the right eye was 20/15, but decreased to counting fingers at one foot in the left eye. Visual fields were normal in right eye but only fair to confrontation in the left eye, being partly constricted above. No details could be made out in the left eye due to a massive vitreous hemorrhage.

The patient was placed on stenopeic glasses and bedrest at home. By December 18, 1951, it still was impossible to see any fundus details but he was allowed more freedom to go about.

By March 12, 1952, vision had improved to 20/40—; however, there still were no reliable fundus details.

Vision steadily improved so that by August he could see 20/25; however, the many clots of vitreous hemorrhage still floated about in such a way that no tear in the retina could be made out. Finally, by December, 1952, what looked like a round operculum could be seen nasally and above but there was no sign of a detachment of the retina. In the meantime the patient had been back to work for many months.

Three months later vision was 20/20, if the patient moved his eye so that the vitreous masses would float out of his line of vision. The operculum could still be seen and it bobbed about. In a direct line with the operculum, and a little more peripherally was an irregular reddish arch, which looked like the edge of a tear in the retina.

When he was last seen on March 11, 1955, vision was still 20/20 and there was no change in the fundus picture; there were still many large clots of blood floating about and the tear could not definitely be seen. This was 39 months after the vitreous hemorrhage.

CASE 7

A 66-year-old white man was seen on December 7, 1951, with the complaint of foggy vision in the left eye for the preceding two days. Vision in the right eye was 20/20 and the fundus was normal. Vision in the left eye was down to counting fingers at three meters because of a vitreous hemorrhage but there was a surprisingly good view of the fundus.

In midline above, far in the periphery, was a typical horseshoe tear with the flap pulled inward toward the vitreous; the edges of the tear were barely visible and appeared whitish. No definite detachment of the retina could be made out.

Five days later the vitreous was more clear and, just temporal to the tear, was an atrophic area with obliterated vessels and some pigment hypertrophy; no elevation of the retina was seen. The patient did not want to be operated upon and consequently was followed closely in the office; in the meantime he wore stenopeic glasses.

By January 19, 1952, the vitreous had cleared markedly, vision had improved to 20/25, and the flap of retina seemed to be flattening out; stenopeic glasses were discarded. The hole became less distinct on subsequent visits and, by August, 1952, there was some definite pigment central to the hole. He was last seen on December, 9, 1952, 12 months after his first visit, at which time vision was 20/20 and the tear could not be recognized.

CASE 8

A 50-year-old white business-woman was seen on February 19, 1952, with the complaint of many sootlike spots and occasional light flashes before the left eye; she recalled that on December 28, 1951, she had fallen on the sidewalk and badly jarred herself; she dated the symptoms as having begun shortly following her fall.

Examination revealed vision in right eye to be 20/20 with a −5.0D. sph. and vision in the left eye 20/20 with a −8.0D. sph. The fundus of the right eye could be seen easily and, far below in the temporal periphery, there was a glistening sheen to the retina; peripheral to this was some irregular pigmentation.

In the left eye was a distinct vitreous haze; in the periphery at the 6-o'clock position were some marked vitreous opacities and, just central to this, was a definite round opacity which floated in the vitreous. The peripheral portion of the opacity could be traced down to the retina, where there was an obvious round hole with some retinal hemorrhage at the temporal edge of the hole. This area could be seen with the binocular direct ophthalmoscope, and the edges of the tear were not elevated; a ribbon of blood could be seen running under the retina temporal to the tear. There was a definite detachment of the vitreous as seen with the Hruby lens.

Nine days later, the flap was a little more difficult to see and the ribbon of blood from under the tear had absorbed. The patient was kept in stenopeic glasses for about a month. By March 20th, some pigment appeared to be forming around the edges of the tear, although the edges of the tear could not be made out easily. The visual field, as always, remained full.

By July 24th, the tear could not be seen, and, by October, the flap could still be seen floating in the vitreous, although anchored to the retina. When last seen on April 8, 1955, over 37 months since her initial visit, her vision was 20/25, and the tear could not be seen; in the area of the tear, the retina was definitely flat, with a pigmented demarcation line around it; the operculum of the tear had finally broken loose from the retina and floated just in front of the retina, casting a shadow on the latter. There were no subsequent changes in the right eye.

CASE 9

A 60-year-old white businessman, on May 21, 1952, shortly after arising in the morning, noticed a "long black line" down and nasally, before the right eye. Visual fields were full and vision was 20/20 bilaterally.

The left eye was not remarkable except for a questionable detachment of the vitreous in the posterior one third. In the right eye was a small oval tear in the temporal superior quadrant, next to three small groups of healed choroiditis; adjacent to this area were two small fresh retinal hemorrhages. There was no detachment of the retina. The patient was placed on stenopeic glasses and, three days later there was no change; a definite detachment of the posterior one third of the vitreous could now be made out in the right eye. He desired conservative treatment and, consequently, was followed closely in the office.

By June 5th, the hemorrhage had absorbed; there was no elevation of the rim of the tear but no fresh pigment in the area could be detected. By July 16th there was a suggestion of pigment forming centrally. When last seen on July 21, 1954, there was no sign of detachment of the retina; the tear was quite difficult to see, and more pigment had formed; the vision remained at 20/20 26 months after the onset of symptoms.

CASE 10

A 59-year-old white woman was seen in consultation on October 28, 1954, with the complaint of a "veil" before the right eye of two days' duration. Vision in right eye was 20/20; best vision in the left eye was 20/25. The only finding of note in the left eye was a detachment of the posterior one third of the vitreous.

The right eye showed a large vitreous opacity floating in the vitreous cavity and attached to the posterior face of the vitreous. With Hruby lens and Goldmann slitlamp, the opacity appeared as a triangular piece of tissue with a hemorrhage on it. Peripheral to this opacity, in the temporal superior quadrant, was a pigmented area in the retina in the fork of a retinal vessel; next to it was an unmistakable retinal hole with the edges turned inward toward the vitreous; no elevation of the retina was seen.

She was placed on stenopeic glasses and seen at frequent intervals. With time, the operculum appeared to shrivel somewhat, and some pigmentation about the tear began to appear. Stenopeic glasses were removed in Mid-December and, when last seen on July 7, 1955, vision was 20/20 and there was no detachment of the retina; the hole, however, was perhaps more easily seen; there was still more pigment formation. A little over eight months have passed since her symptoms began.

CASE 11

A 55-year-old white steel-worker was seen on November 19, 1947, with a vitreous hemorrhage in the left eye. Vision was 20/20 in each eye, and the right eye was not remarkable. The left eye showed no detachment of the retina.

He was examined again on November 21st, at which time in the left eye could be seen a grayish area of retina temporally and above, with a questionable early horseshoe tear. He was seen frequently and, by November 26th, a definite horseshoe tear had developed at this site, with the formation of another smaller tear just below it. By this time a definite elevation of the retina could be made out from the upper of the two tears down to horizontal; vision was still 20/20.

A partially penetrating diathermy procedure was carried out November 28th. The postoperative course was not remarkable. However, postoperatively, the central visual acuity could never be improved over 20/40, and the visual field which had been full to a three-mm. white object at 330 mm. before operation, has remained constricted to 40 degrees, extending to 60 degrees temporally.

On August 6, 1951, he came into the office with the complaint of a "little blurry vision in the right eye for five days." Visual acuity of right eye was 20/20, and the field was full. Far in the upper temporal periphery was a grayish area without a visible tear; a faint but definite detachment of the posterior one third of the vitreous was seen. He was examined often and, by September 7th, a definite tear could be made out in the suspicious area, with no elevation of the retina central to it. From his previous experience, the patient preferred a "conservative" course, so that he continued to be followed in the office. By January 24, 1952, he was forming definite pigmentation central to the tear and, as recently as February 2, 1954, vision was 20/25 plus and the hole less obvious.

He reported back on February 8, 1954, two and one-half years after the onset of symptoms in the right eye, stating that over the weekend he had noted flashes of light and a shadow before the right eye. Vision was still 20/25, and there was now an obvious retinal detachment temporal and above, with a small horseshoe tear; just above this was a second round hole. There was a definite detachment and collapse of the vitreous.

He entered the hospital the same day and, after 24 hours of bedrest, the detachment had almost completely flattened out. At operation on February 12th, a third hole was discovered in the periphery under the external rectus muscle and below the original horseshoe tear. During surgery, care was taken to "cool" the eye frequently with saline between diathermy applications to avoid overheating. Convalescence was uneventful and, when last examined on May 5, 1955, vision was 20/25 in the right eye and 20/60 in the left eye.

CASE 12

A 60-year-old violinist was seen in consultation on September 24, 1951, because of a vitreous hemorrhage in the right eye. Vision was 20/30 in each eye was a −3.0D. sph.; visual fields were normal in each eye except for a small inferior nasal notching in the right eye. The patient had been under care for glaucoma and the defect in the field had been present for some time.

The left eye was not remarkable except for moderate glaucomatous cupping. The disc in the right eye was similar to that in the left. Temporal and above, toward the 10-o'clock position, was a round, moderately pigmented choroidal focus; the arteriole running just below this was definitely pulled into

the vitreous, without pulling the retina with it. The vessel came off the retina about two disc diameters central to the choroidal focus, and again settled to the retina about two to three disc diameters peripheral to it.

With the binocular direct ophthalmoscope, the retina could be seen to be definitely attached under the elevated arteriole. Attached to the arteriole were two small grayish opacities which swung in the vitreous with movements of the eye. With the Hruby lens there was an obvious total detachment of the vitreous, the posterior face being easily traceable to the grayish opacities on the elevated artery.

The patient was placed on stenopeic glasses and followed closely. The vitreous hemorrhage slowly cleared.

In late March, 1954, having returned to work many months before, he suffered a second vitreous hemorrhage. This time the vessel appeared much as before but the retina below it was definitely detached. The same evening he was operated upon with partially penetrating diathermy and perforating pins; at surgery, a definite tear could be made out under the operculum.

Convalescence was not remarkable, and the arteriole remained elevated in the vitreous. Vision slowly improved so that by October, 1954, it was 20/15. In December, 1954, he suffered another vitreous hemorrhage, vision falling to hand movements. The field has remained the same, and the hemorrhage is reported to be slowly clearing with no evidence of retinal detachment, although the fundus could not be seen well.

CASE 13

A 36-year-old white man, a schoolteacher, was first seen on August 7, 1952, because of a retinal detachment in the right eye; this was operated upon three times without success. At the time of his first visit, vision in left eye with compound myopic prescription was 20/25 plus, and the visual field was full. Tension in left eye was elevated and pupil was not dilated at that time; however, the fundus examination was normal through a normal-sized pupil.

He was followed for the next several years, the tension in left eye remaining controlled with two-percent pilocarpine. Numerous visual field tests were normal, and vision was 20/20 with the proper glasses.

On June 18, 1955, the patient suddenly noted "streamers" down to the left in front of the left eye. Fundus examination after 10-percent neosynephrine drops revealed the retina in place everywhere; a slight vitreous haze from the vitreous hemorrhage was present. A typical flap of retina was pulled into the vitreous cavity nasally and above; the vitreous was disorganized and no obvious attachment of the vitreous could be traced to the flap. The retinal tear could just be made out under the flap. About the area were atrophic myopic patches with very little pigmentation.

On June 22, 1955, a partially penetrating diathermy procedure was performed on the left eye and the tear was surrounded. All of the diathermy applications showed up well in the fundus. The postoperative course was uneventful and, when seen last in the office on September 2nd, two months after surgery, the corrected vision in the left eye was 20/25 plus, and the visual field was full.

CASE 14

A 57-year-old white man was seen in June, 1947, with a retinal detachment in the right eye. At that time there was a large bullous detachment above, extending through the macula, and three coalescing horseshoe tears above. Partially penetrating diathermy was performed at that time and a cure resulted, improving vision from 20/100 to 20/25 and restoring a full visual field.

He was again seen on January 11, 1952, with a history of "spots" before the left eye for five days and then blurry vision for three days. Several days before the symptoms began, he had struck his head on a cupboard door at home.

Vision in the left eye was 20/40, with a full visual field. The vitreous was moderately hazy due to a vitreous hemorrhage, and temporal and above was what appeared to be a flap, with some obliterated vessels on it. There was no detachment of the retina.

He was placed on stenopeic glasses and bedrest; the following day the fundus could be seen more clearly. The flap could be seen to be moderately elevated into the vitreous but there was no elevation of the retina. He was seen at frequent intervals in the office, having decided that he would like to delay surgery if possible.

By January 18th, the vision had improved to 20/25 but the lips of the tear could now be seen to be elevated. The next day there was an obvious elevation of the retina for about one and one-half disc diameters central to the hole. On January 19th, a partially penetrating diathermy procedure was performed. When he left town for home on February 7th, retina was attached, the visual field was normal, and the visual acuity was 20/30. He has not been heard from since.

CASE 15

A 57-year-old man was seen in consultation on November 13, 1952. Two weeks previously the patient had a vitreous hemorrhage in the left eye and, a few days later, his physician had discovered a flap of retina nasally and above. Vision was 20/20, right eye; and 20/20—, left eye, with full vision fields. The right eye was not remarkable but for a suggestion of a vitreous detachment in the posterior half.

In the left eye there was a large flap of retina pulled into the vitreous at the 10-o'clock position in the periphery; behind the flap was a tear in the retina, best seen with indirect illumination. Almost in midline above was a questionable early tear consisting of a grayish area in the retina and what appeared to be a flap. With the Hruby lens a detachment of the vitreous could easily be made out but it could not be traced to the flap.

A few days after consultation the retina detached

and he was operated upon by his referring physician; as of June, 1954, vision was 20/20 in the left eye.

CASE 16

A 64-year-old schoolteacher was seen December 8, 1954. One week previously she had first noticed "black lines" in front of the right eye. She was seen by her oculist on December 6th, at which time the vision in the right eye was counting fingers at three feet; vision in the left eye, 20/20. Visual fields were normal in both eyes.

The right eye revealed a marked vitreous hemorrhage; far temporally, at the 10-o'clock position, a flap of retina could be seen pulled slightly into the vitreous; just central to it the retina was a little grayish but there was no definite detachment. Just below this was a similar area which was probably cystic. With the Hruby lens, a definite detachment of the vitreous could be made out, but it was impossible to trace it to the tear.

She was placed on rest at home and stenopeic glasses. Vision slowly improved to 20/40, and the vitreous opacities gradually settled so that, on December 13th, the tear could be well visualized; the lower border seemed to be dark red, as if this were where the hemorrhage into the vitreous originated. With the Hruby lens, the edges of the tear could now be made out and the central portion was seen to be somewhat elevated.

The patient eventually decided she would rather have surgery and was to rest at home over the weekend and to come into the office on the way to the hospital. When seen on December 21st, on the way to the hospital, there was an obvious early bulla temporal and above, with the edges of the tear showing easily. After 12 hours of bedrest in the hospital, the retina had settled again but the lower edge of the tear was still elevated. On December 23rd, she was operated upon with partially penetrating diathermy; during surgery the retina became detached again so that several perforating pins were placed for drainage.

When last seen on June 20, 1955, the retina was attached everywhere, the visual field was full, and the corrected vision was 20/20, almost four months after surgery.

CASE 17

A 56-year-old white man was seen on July 21, 1944. In May of the same year, as a fireman, he had bumbed his right eye with a firehose. Following this he noted some black spots and slowly the vision decreased. A shadow eventually appeared and, in the week previous to his first visit, the shadow had spread considerably. The best vision in the right eye was finger counting at one meter, the visual field was absent below.

Examination revealed a tremendous bullous detachment temporally and above in the right eye, hanging well down over the macula, with a flat detachment of the retina extending well below the macula. Five tears could be made out. The left eye could see 20/20 and had a full field. The right eye was operated upon July 29th, with partially penetrating diathermy; postoperatively, the retina went back into place and he was dismissed. However, early in September, he developed a total detachment of the retina with a vitreous retraction; reoperation was considered hopeless and vision gradually was lost so that he had no light perception.

In November, 1944, he noticed flashes of light before the left eye and examination revealed three very early flap tears of the retina, with the flaps barely elevated and no perceptible detachment of the retina between them; the tears were located at the 1-o'clock, 3-o'clock, and 4-o'clock positions in the midperiphery.

The following day the lower edge of the tear at the 1-o'clock position could be seen to be elevated, and the flap pulled into the vitreous. A suspicious glistening spot in the retina could be seen temporal to the tear at the 1-o'clock position. At surgery on November 25, 1944, this area was confirmed as a tear, with the flap showing up quite well. When last seen on June 28, 1954, vision in the left eye was 20/20— and the visual field full almost 10 years after surgery.

CASE 18

A 61-year-old white man was seen in April, 1949, with a detachment of the retina above in the left eye, due to three tears. There had been vague symptoms of blurring of vision for the previous eight months. He was successfully operated upon with diathermy on April 13, 1949. Vision in the right eye was 20/20, and the fundus was normal.

On March 26, 1951, he was seen with the complaint of "soot" before the right eye for a few days. Vision in the right eye was a poor 20/30 but the visual field was normal. There was a moderate vitreous hemorrhage in the right eye but the retina appeared to be flat. In the temporal periphery at the 9-o'clock position was a small horseshoe tear and, floating just in front of this in the vitreous, there was a tiny flap of retina. Attached to the flap of retina was a tiny branch of a retinal artery; the flap of the horsehoe tear was elevated but the edges of the tear were not elevated.

With the Hruby lens, a detachment of the vitreous could be seen easily. Although the vitreous could not be directly traced to the flap of the tear, the latter moved with ocular rotations as if it were being tugged by a strand of vitreous.

On March 27, 1951, a partially penetrating diathermy procedure without any perforations was performed. When last seen on March 31, 1954, vision in the left eye was 20/30, while vision in the right eye was 20/25, three years after surgery.

CASE 19

A 58-year-old white woman was seen in consultation on April 27, 1951. About five weeks earlier she had noticed some flashes of light before the right eye and some blurring of vision; vision at that time was 20/30. A large floating vitreous opacity and a questionable flap of a tear pulled into the vitreous had been found.

Vision slowly improved until suddenly, on April 27th, it again became cloudy. Vision in right eye

was reduced to 20/300; the left eye had been phthisical since childhood, with no light perception. The cause was unknown. The visual field in the right eye was full; the vitreous was moderately hazy, and at the 12-o'clock position in the periphery could be seen a grayish flap sticking into the vitreous with what appeared to be a small clot of blood attached to it; the vitreous was sufficiently hazy to obscure any further details.

After two days of bedrest in the hospital with binocular bandages, the vitreous was much clearer and good fundus details were visible. The flap previously seen was definitely attached to the retina and, under it was a large hole torn in the retina, with its edges turned inward to the vitreous. What had earlier looked like a small clot of blood could now be made out as a retinal arteriole which spanned the gap between the attached retina at the edge of the tear and the flap; some pigmentation on the flap could also be seen.

On May 1st, operation was attempted but the cornea became so hazy that accurate details of the fundus could not be discerned; the conjunctiva was closed and patient returned to her room. Three days later she was brought back to surgery, the conjunctiva readily pulled open with minimal bleeding, and a partially penetrating diathermy barrage was placed around the hole, which was now easily visible again.

When last examined in November, 1954, the retina was attached everywhere and vision was 20/20, over three years after surgery.

CASE 20

A 56-year-old white businessman was seen on February 21, 1952, with the complaint of "a floating spot" in front of the right eye which had been present since a fit of coughing five days previously. Vision was 20/20 in each eye and the visual fields were normal.

The fundus of the left eye was normal and there was an obvious detachment of the vitreous in the posterior one third.

In the right eye was a typical tear with a long flap pulled into the vitreous, situated at the 12-o'clock meridian in the periphery; there was also a detachment of the posterior one third of the vitreous in this eye. The nasal edge of the tear could be seen easily; it was not elevated.

The patient felt that he would prefer surgery to observation and, on February 26th, he underwent a partially penetrating diathermy operation. Convalescence was not remarkable and, when last seen July 14, 1955, the retina was attached everywhere; the visual field was normal; and central acuity was 20/20, over three years after surgery.

CASE 21

A 57-year-old white woman, a tax consultant, was seen on March 10, 1952, with a history of recurrent small vitreous hemorrhages in the left eye for the previous several months. The last hemorrhage had been one month previously and was worse than the rest. The right eye, with an aphakic correction, read 20/20. Vision in the left eye with a —4.0D. sph. was 20/25, the decrease being due to an early nuclear sclerosis. Visual fields were full.

Examination of the left eye revealed a tear in the midperiphery just about the 3-o'clock meridian, with the flap pulled well into the vitreous. The tear could be seen with the binocular direct ophthalmoscope, and its edges were turned into the vitreous. There was a questionable elevation at the lower edge of the tear but otherwise the retina was definitely attached. There was an old healed choroidal focus at the apex of the tear, and some obliterated vessels on the flap of the tear. With the Goldmann slitlamp and Hruby lens a detachment of the vitreous could easily be seen, but it could not be traced to the flap.

She was operated upon March 11th, using partially penetrating diathermy. At surgery, the retina was definitely more detached than on the previous day. The postoperative course was unremarkable. The nuclear sclerosis progressed in the left eye so that on November 2, 1954, an extracapsular cataract extraction was performed. Vision on April 20, 1955, was 20/20 with her aphakic correction, three years after surgery.

CASE 22

A 44-year-old housewife was seen June 16, 1953, in consultation because of flashes of light before the right eye of three weeks' duration. In January, 1953, the left eye had undergone an unsuccessful retinal detachment operation, the vision now having fallen to hand movements. At that time her doctor had noted "a few pigmented degenerative foci in the superior temporal quadrant of the right eye."

When seen in June, 1953, the vision in the right eye was 20/30—; temporal and above from about the 9-o'clock to 12-o'clock positions in the periphery was an area of healed chorioretinitis. At the central border of this area was a very long, almost crescent-moon fold of retina being pulled into the vitreous and leaving what appeared to be a tear. The peripheral portion of the retina seemed to be elevated. Toward the 11-o'clock position was a small hemorrhage at the central lip of the tear.

With the Hruby lens there was a definite detachment of the posterior one half of the vitreous, which could be traced to the crescent-shaped area of the retina. With the binocular direct ophthalmoscope, the retina in the periphery appeared either edematous or slightly elevated. She was referred back to her oculist with a recommendation for surgery.

When last seen on December 21, 1954, vision was 20/25—1. The retina was attached centrally, with a well-healed operative barrage of choroiditis. The central lip of the tear could still be faintly discerned, but there was no evidence of elevated retina, one and one-half years after surgery.

CASE 23

A 59-year-old white banker was seen February 25, 1952, because of an incipient cataract in the right eye. Vision in the left eye had been poor since the age of three years.

The right eye was not remarkable and the left eye showed, in the macular and paramacular area, an oval atrophic focus; far above and temporally in the periphery was a very large (four disc diameters) atrophic, healed choroidal focus; in the upper nasal quadrant was a similar but smaller area.

By December, 1953, vision in the right eye had decreased enough so that cataract surgery was advised and performed on the right eye on February 27, 1954. During the extraction, the capsule was torn but the lens material was expressed and irrigated out, resulting in vision of 20/20 by late March.

On May 12, 1954, he came into the office with the complaint of having "many spots and blurred vision" of the right eye since the previous day. The vitreous was moderately cloudy, especially in the nasal half, allowing only a good view of the fundus centrally and in the upper temporal quadrant. Two days later vision was 20/40— and the vitreous much more clear. There could be seen far in the periphery toward the 11-o'clock position a dark grayish-black area almost like the lid of a horseshoe tear with some flecks of blood on it; there was no obvious hole in the retina.

He was advised to wear stenopeic glasses and to stay quietly at home. By May 18th, a definite flap of retina could be seen pulled into the vitreous; he was urged to have surgery but preferred to wait.

The retina remained flat at the central tip but questionably elevated at the base of the flap. He finally decided to undergo surgery and so, on July 13th, a partially penetrating diathermy operation was performed. The first application of diathermy touched the central edge of the tear and showed the edge of the tear to be raised much more than expected. The postoperative course was smooth and, when last seen on July 15, 1955, vision was 20/20, 12 months after surgery.

CASE 24

A 57-year-old man had been seen in the office for many years for refractions. Early in December, 1948, he noticed some black spots before the left eye and, when seen on December 18th, there was a round opacity floating in the vitreous of the left eye towards the 10-o'clock meridian. Behind this and a little more peripherally was a long oval hole. The lower border of the tear was definitely elevated; no hemorrhage nor exudate was visible in this region. A definite detachment of the posterior one third of the vitreous could be seen; the floating opacity was attached to the posterior surface of the detached vitreous. It was explained to him that surgery would probably be necessary. He had a slight cold at the time and so was followed closely in the meantime.

On December 28th, he underwent partially penetrating prophylactic diathermy and had an uneventful course. When last seen on December 22, 1954, vision was 20/25 (having been 20/20— preoperatively) and the retina was well healed, six years after surgery.

CASE 25

A 69-year-old woman was seen on January 10, 1955, with the complaint of flashes of light and some black floaters; the previous night a cork from a soda-water bottle had struck her left eye.

She had been a patient for some time previously, having first been seen because of a retinal detachment in the right eye which had been present for several months. This eye had been operated upon but not cured, and the vision was gradually lost. The vision in the left eye had slowly decreased from 20/20 to 20/50, due to nuclear sclerosis.

When seen in January, 1955, there was no light perception in the right eye and vision in the left eye was 20/50. Fundus examination revealed, in the upper temporal quadrant, a typical horseshoe tear at the 2 o'clock position, with the flap pulled somewhat into the vitreous. There was some pigment on the edge of the flap and a vein crossed the gap between retina and the flap from above, while an artery crossed the gap just at the apex of the tear. There was no elevation of the adjacent retina. Elsewhere in the periphery were some irregular foci of pigmentation and diffuse atrophy.

With the Hruby lens, one could make out a detachment of the posterior one third of the vitreous. It is interesting that in October, 1954, she had been seen for a routine refraction; at that time there was a small black (one-third disc diameter) focus of healed choroiditis in the upper temporal retina at the 2-o'clock meridian and no obvious detachment of the vitreous could be made out.

Surgery on the eye was advised but she wanted to postpone it, so she was placed on stenopeic glasses and followed in the office. No particular change occurred during the next two weeks but, when she was seen on January 26th, the lower edge of the tear was much more prominent and was definitely turned out into the vitreous.

She decided to undergo surgery, and, on January 29th, a partially penetrating diathermy barrage was placed about the tear. At surgery a limited detachment could be made out from the appearance of the diathermy foci. One perforating pin was placed and barely drained; a longer perforating electrode was then used and this caused moderate drainage.

The postoperative course was smooth and, when last seen on June 13, 1955, vision was 20/50 and the retina was flat everywhere; the flap of retina had retracted and settled down to the scarring chorioretinitis almost 35 months postoperatively.

CASE 26

A 58-year-old housewife was seen July 29, 1953, with the complaint of "smoky" vision in the right eye of one week's duration. Vision in the right eye 20/100, vision in the left eye 20/30. The visual field of the right eye was greatly reduced to a three-mm. white target at 330 mm., while the field in the left eye was full.

Fundus examination revealed a large detachment of the retina in the right eye, over the upper half and extending through the macula. There was a large fishmouth tear nasal and above. The vitreous was detached in the posterior one half.

Examination of the left eye revealed the retina to be attached but there was a definite tear in the retina with a flap pulled into the vitreous cavity; a faint posterior vitreous detachment could be made out but could not be traced to the flap of the tear. She entered the hospital that evening and, with bedrest, the detachment in the right eye receded considerably.

A partially penetrating diathermy operation was performed on the right eye on August 4th but was unsuccessful. Two scleral resections were later performed on September 28th and on January 25, 1954, but to no avail.

A partially penetrating diathermy operation was performed on the left eye on January 22, 1954, with uneventful convalescence. When last examined December 8, 1954, vision in the right eye was reduced to hand movements at one meter, while vision in the left eye was 20/20 and the visual field was normal, 11 months postoperatively.

CASE A

*Demonstrating bilateral detachment, unsuspected in one eye*

A 62-year-old white man, a laborer, was seen December 4, 1951, with a history of "spots and floaters" before the left eye since November 6th, with the vision suddenly becoming much worse on November 28th. Vision in the right eye was 20/20; that in the left eye was decreased to 20/400. The visual field was full in the right eye; the lower temporal quadrant of the left eye was out to a three-mm. white target at 330 mm.

In the left eye there was a bullous detachment over the upper half with a flat detachment of the lower temporal quadrant. There were seven tears in the midperiphery over the temporal half and a detachment of the posterior two thirds of the vitreous.

The right eye revealed a limited detachment of the retina in the superior temporal quadrant, with a small oval hole, best seen by indirect ophthalmoscopy, in the extreme periphery at the 9-o'clock position. After 24 hours of bedrest in the hospital, the detachment in the right eye had receded considerably, while the detachment in the left eye had settled only slightly.

On December 7th, the right eye was operated upon with partially penetrating diathermy and three perforating pins for drainage. On December 18th, the left eye was operated upon in a similar manner, with 17 perforating pins. Convalescence was uneventful and, when last seen on January 6, 1955, vision in the right eye was 20/25; vision in the left eye, which had been 20/100 in January, 1953, had decreased to counting fingers because of a marked nuclear sclerosis of the lens. Visual fields in both eyes were full.

CASE B

*Demonstrating superiority of binocular bandages to stenopeic glasses*

A 21-year-old white housewife was seen in December, 1952. In August, 1951, she had blurred vision in the right eye, consulted an eye physician, and was given bedrest for three and a half weeks; at that time she was told "the swelling of the retina has gone down," and she flew home to the midwest. While home she was seen by another oculist who told her everything was "fine" and prescribed cortisone and nicotinic acid. Vision in the right eye had steadily become worse and, when examined in December, 1952, had decreased to counting fingers at 10 feet.

Vision in the left eye was 20/20. This eye was not remarkable except for moderate myopic changes.

Visual fields in the right eye were normal to a three-mm. target at 330 mm. but the upper half was absent to a two-mm. white target at one meter. The right eye revealed a rather flat detachment over the lower two thirds of the fundus, with a pigmented demarcation line nasally and above at the 2-o'clock position. The retina did not move freely and far in the periphery at the 8-o'clock position was a small round hole.

She was put on bedrest at home and, after three weeks, there was little or no change; however, another small hole in the retina was discovered at the 7-o'clock position.

She was admitted to the hospital on January 14th and, after 24 hours of bedrest with binocular bandages, there was marked settling of the retina so that, by January 17th, there were only a few retinal vessel shadows in the periphery to indicate the area of detachment.

She was operated upon the same day, a double barrage of partially penetrating diathermy being placed about the area of the two tears. Six days later funduscopic examination revealed the retina to be well in place, with very little pigment formation from the diathermy. On January 27th, the retina was again flatly detached below; it again spontaneously settled slowly and she was given stenopeic glasses on February 1st. The retina remained in place and, when last seen in May, 1953, it was definitely attached everywhere. Vision had improved to 20/100 but the visual field defect remained as it was originally.

CASE C

*Demonstrating discovery of tear with recurrence of detachment*

A 60-year-old white man, a truck driver, was seen January 27, 1954. One year previously he had undergone bilateral cataract extractions elsewhere, with resulting vision of 20/20. The patient stated he had noted a blur before the left eye for five days; there were no complaints referable to the right eye. Vision in the right eye was 20/40; in the left eye, reduced to 20/400.

The left eye revealed a retinal detachment over the lower temporal half, with a typical horseshoe tear in the midperiphery at the 3-o'clock position and two slitlike tears just above it. The macula was detached. There was a detachment of the posterior one fourth of the vitreous.

The right eye showed a smooth detachment of the retina far temporally, with no obvious tear

but a hemorrhage in the retina in the periphery at the 9-o'clock position.

The patient was sent home for bedrest with binocular bandages and, when examined at home on January 31st, there was no sign of the detachment in the right eye, while the detachment in the left eye had settled considerably. He was hospitalized on February 3, 1954, and, two days later, a partially penetrating diathermy barrage was placed about the tears in the left eye, as well as perforating pins within the barrage. The postoperative course was uneventful. During his stay in the hospital, the retina in the right eye remained absolutely flat. It was decided to postpone surgery on the right eye in an effort to see where the detachment would recur, and if one could then find a tear.

He was dismissed from the hospital on February 21st, wearing stenopeic glasses and was seen in the office frequently until April 1st, at which time the glasses were removed.

During this time, there was no sign of a recurrence of the detachment. He was next seen in the office on April 8th, having noticed "a slight blur" before the right eye the same day.

Vision in the right eye was 20/25 plus and examination revealed a retinal detachment temporally, as before, but this time with three obvious small horseshoe-shaped tears, fairly centrally. Whereas the initial examination revealed only a questionable detachment of the vitreous in the right eye, he now had an obvious vitreous detachment.

After four days of bedrest with binocular bandages at home, there was no obvious settling of the retina. He was admitted to the hospital on April 12th, and a procedure of diathermy similar to the first was performed on April 15th. The postoperative course was uneventful. When last examined on January 28, 1955, vision in each eye was 20/20.

### Case D

*Demonstrating danger of "simple" diathermy operation*

A 52-year-old widow was seen for a routine refraction on August 27, 1954. In June, 1952, she had been operated upon successfully for a retinal detachment in the left eye due to a tear nasally and above. Refraction in August, 1954, revealed vision of 20/15 in each eye; visual fields were normal but for a slight cut nasally and above in the right eye. The left eye showed the retina to be well attached.

In the right eye, through a small pupil, a detachment of the retina temporal and below could be made out. Dilated fundus examination revealed a limited retinal detachment with a tremendous horseshoe-shaped tear at the 8-o'clock meridian, with the flap pulled well into the vitreous. Looking through the tear in the retina one could see some old pigmented choroiditis beneath (fundus examination in June, 1952, had revealed an irregular, almost leaf-shaped, patch of pigment hypertrophy in this region; there was at this time only a suggestion of a vitreous detachment). At this examination there was a marked detachment of the vitreous.

With bedrest, the detachment had settled somewhat but the tear remained wide open. At operation on August 31st, the tear was easily localized just in front of the ampulla of a vortex vein; the ampulla was wide and ran parallel to the limbus. A partially penetrating barrage of diathermy was placed, surrounding the tear and going behind the vortex vein. Several perforating pins were placed behind the vein, and three were placed in front of the ampulla. On withdrawal of the pins there was good drainage but bleeding occurred from two of the anteriorly placed pins; this was stopped with increased partially penetrating diathermy at the bleeding site. Fundus inspection showed a stream of blood coming out of the tear and into the vitreous; further temporally was what looked like a massive hemorrhage in the retina and from here was a very heavy streamer of blood which spread out centrally.

Postoperatively, there was, of course, a marked vitreous hemorrhage but the retina appeared flat centrally. She was placed on cortisone orally on the second postoperative day and remained in the hospital at bedrest for 15 days.

On September 22nd, vision suddenly went bad and, when seen two days later (the patient lived out of town), there was a total detachment of the retina except temporally and below in the area of the recent diathermy; the entire picture was that of a massive vitreous retraction.

On October 2, 1954, a lamellar scleral resection of the upper half of the globe was performed, in a vain effort to reattach the retina. When last seen on November 2, 1954, vision in the right eye was faulty hand movements, vision in the left eye 20/15.

## Discussion of cases

### Group I

Consideration of the first group (Cases 1-10) shows that, in those patients who were seen with a clinical tear of the retina and who have failed to develop a detachment of the retina, the most apparent common factor was that the majority had a freely floating operculum in the vitreous. Each of these patients had a single tear, and in seven of the 10 the "lid" of the retina tear had become completely separated from the retina, leaving the retina and its tear in place.

In one of the three cases without a free operculum, the hole was situated in the midst of an area of old chorioretinitis and there was no visible attachment of vitreous to a flap of retina (Case 9). In the other two

TABLE 1

GROUP I: RETINAL TEARS WITHOUT SUBSEQUENT DETACHMENT

| Case number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Months followed | 99 | 89 | 84 | 75 | 38 | 39 | 12 | 37 | 36 | 8 |
| Other eye detached | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Number of tears | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Locale of tears | H | H | A | H | H | A | A | B | A | A |
| Free operculum | X | X | X | X | X | X | | | | X |
| Attached flap | | | | | | | X | X | | |
| Hole | | | | | | | | | X | |
| Adjacent old chorioretinitis | | X | | | | | X | | X | X |
| Appearance of pigment (wk.) | 4 | ? | 90+ | 4 | ? | ? | 30? | 4 | 8 | 6 |
| Vitreous hemorrhage | X | 0 | X | X | X | X | X | X | X | 0 |

X.....Present
0.....Absent
H.....Horizontal
A.....Above horizontal
B.....Below horizontal

cases the lid was still attached to the retina—in one instance (Case 8), the tear was situated in the periphery below so that gravity and the early formation of pigment were perhaps of considerable value in keeping the retina in place. In the second of these two cases (Case 7), there was adjacent old chorioretinitis which must have provided a secure enough attachment to prevent separation.

In eight of these 10 cases, there was a variable degree of vitreous hemorrhage, which would seem to indicate that the presence of a vitreous hemorrhage is not always a bad prognostic sign.

In none of these 10 cases was there a detachment or had there been a detachment of the retina in the fellow eye; this, of course, does not eliminate the possibility that a retinal detachment may develop in the second eye in the future.

The formation of new pigment in the region of the tear was a variable phenomenon and it may be clinically misleading. The presence of an old chorioretinitis adjacent to the edges of the tear may give more comfort to the ophthalmologist than he receives from the daily anticipation of fresh pigment hypertrophy.

Bilateral development of retinal detachment is common; in our experience, approximately 20 percent of patients with detachment of the retina have already sustained one in the other eye. After excluding cases due to perforating injuries, those following shortly after difficult cataract extractions, or cases of oral disinsertions, this percentage may rise to approximately 25 percent.

In a study of 451 patients Smith and Pierce[74] discovered bilaterality of detachment in 27 percent; in over 500 cases, Shipman[75] found bilateral involvement in 20 percent and felt that, with time, the percentage would increase.

Of the 26 cases presented in this paper, seven had a previous retinal detachment in the other eye; and of the four illustrative cases (A to D) three had detachments in both eyes. The time-elapse between detachment in the first and second eye is extremely variable. In Cases A and C the detachments were simultaneous; in Case 17 the interval was four months; this interval increased to over five and seven years in Cases 14 and 11, respectively.

### GROUP II

In the second group of patients (Cases 11-16) who were followed and who eventually developed a detachment of the retina, all but one (Case 12) had vitreous adherent to a flap of retina which remained attached to the margin of the tear.

The tear was located above horizontal in all of these patients; however, there were

TABLE 2

GROUP II: RETINAL TEARS WITH SUBSEQUENT DETACHMENT

| Case number | 11 | 12 | 14 | 15 | 16 |
|---|---|---|---|---|---|
| Days followed | 870 | 360 | 8 | 5 | 13 |
| Other eye detached | X | 0 | X | 0 | 0 |
| Number of tears | 3 | 1 | 1 | 2 | 1 |
| Locale of tears | A | A | A | A | A |
| Free operculum | | X | | | |
| Attached flap | X | | X | X | X |
| Hole | X | | | | |
| Adjacent old chorioretinitis | | X | | | |
| Appearance of pigment (wk.) | 20? | | | | |
| Vitreous hemorrhage | 0 | X | X | X | X |

X.....Present
0.....Absent
H.....Horizontal
A.....Above horizontal
B.....Below horizontal

an equal number in the first group of patients with tears above horizontal, so that it seems that the location of the tear only assumes greater importance when the "lid" of the tear remains attached to the retina.

In two of these five patients there had been a detachment of the retina in the fellow eye. The vitreous hemorrhages encountered in these patients were no more severe than those in the patients who did not develop a detachment of the retina. In only one of the cases was there any evidence of old healed chorioretinitis (Case 12).

Case 11 is interesting in that the time elapsed between the appearance of the first tear and the development of detachment of the retina was about 29 months; when the retina did detach, two new additional holes were apparent. Case C is somewhat similar in that, when first seen, no tears could be found in the retinal detachment in the right eye; the retina settled out and remained attached for just over two months, at which time it detached, shortly after removal of the stenopeic glasses; at that time three definite small horseshoe tears were easily seen.

Case B might be cited at this time to illustrate the fact that an inferiorly placed detachment with a small hole may persist for a long time, most likely settling considerably during sleep, and that spontaneous reattachment is not the rule.

Another point to be considered is that directions to wear stenopeic glasses and resort to bedrest at home are rarely followed by the patient as closely as might be desired; binocular bandages and bedrest overnight in a hospital is frequently followed by surprising settling of the retina, even after the routine recommended for home has apparently accomplished nothing.

## GROUP III

There were 11 patients (Cases 13, 17-26) upon whom prophylactic procedures were performed. Except in one patient whose preoperative and postoperative visions were both 20/50 due to cataractous changes (Case 25), the final vision in all of these patients was 20/25 or better.

Ten of these 11 patients had a flap of retina adherent to the edge of the tear and projecting into the vitreous cavity. In one patient, there was a free operculum in the vitreous. The fellow eye had suffered a retinal detachment in six of the cases. In one other case the second eye had been phthisical from childhood from unknown causes; in three other cases the patient preferred surgery to prolonged observation.

At surgery, three of the patients (Cases 21, 23, and 25) showed elevation of the retina adjacent to the tear, as evidenced by the appearence of the choroidal exudate which was definitely under and not in the retina, as would be expected if the latter were absolutely attached.

It is interesting to speculate as to how

TABLE 3

GROUP III: RETINAL TEARS WHICH WERE OPERATED UPON PROPHYLACTICALLY

| Case number | 13 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Months followed postoperatively | 2 | 119 | 36 | 43 | 41 | 37 | 18 | 12 | 72 | 3 | 11 |
| Other eye detached | X | X | X | ? | 0 | 0 | X | 0 | 0 | X | X |
| Number of tears | 1 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Locale of tears | A | A | H | A | A | H | A | A | A | A | A |
| Free operculum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | X | 0 |
| Attached flap | X | X | X | X | X | X | X | X | 0 | X | X |
| Hole | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Adjacent old chorioretinitis | X | 0 | 0 | 0 | 0 | X | X | 0 | 0 | X | 0 |
| Vitreous hemorrhage | X | 0 | X | X | 0 | X | 0 | X | 0 | 0 | 0 |
| Final vision | 6/7 | 6/6 | 6/7 | 6/6 | 6/6 | 6/6 | 6/7 | 6/6 | 6/7 | 6/15 | 6/6 |

X.....Present
0.....Absent
H.....Horizontal
A.....Above horizontal
B.....Below horizontal

many of these cases in which prophylactic operations were performed might have developed a detachment eventually. As already noted six of the cases (Case 13, 17, 18, 22, 25, and 26) had a detachment in the fellow eye so that probably at least one of these patients would have progressed to detachment. Two more cases (Cases 21 and 23) showed elevation of the retina at the time of surgery; an additional case (Case 20) had a tear above horizontal, with an attached flap pulled into the vitreous and with no adjacent healed chorioretinitis, a situation that seems to have all the qualifications for detachment.

All of the 26 patients presented had visual symptoms, which consisted of 'spots," "whirling things," "flashes of light," "veils," and "soot." Not all patients with a clinical retinal tear or a retinal detachment have symptoms but by far the majority do so. Occasionally, however, the patient is not a good observer, and three illustrative cases of this are A, C, and D.

Case A had an almost total detachment in the left eye; however, a definite, though limited, detachment of the retina in the right eye was symptomless. Case C also had bilateral detachments but was only aware of the detachment in the left eye. It is understandable that the symptoms of the more affected eye were so overwhelming in these two patients that they were unaware of the disorder in the other eye; however, it is neglect not to examine carefully the "unaffected" eye.

Case D also was unaware of any defect in her right eye, although she had experienced a retinal detachment in the left eye two years previously. This patient also demonstrates the inescapable fact that potential tragedy accompanies each diathermic application. Massive bleeding within the eye from a ruptured choroidal vessel, most likely one of the tributaries of the vortex vein, led to a vitreous retraction and loss of all useful vision in that eye.

The procedure used in the prophylactic operations was one of partially penetrating diathermy electrocoagulation in the sclera, using the Walker diathermy unit; the electrodes varied from 0.5 to 1.0 mm. in length, and the amperage readings usually ranged between 20 and 30 ma.

The break in the retina was carefully localized by direct ophthalmoscopy, marking the exit of the light on the sclera with gentian violet. A double row of diathermic applications was then placed behind and around the locale of the tear, bringing the arms of the barrage up to the region of the ora serrata, which is approximately 8.0 mm. from the limbus in the average eye. No perforating applications were made under attached retina.

An added precaution, which has been advocated by Lindner, is the frequent applica-

tion of saline to the globe to prevent excessive heating, with its possible deleterious effects on the vitreous. The use of cutting current (as in the Bovie and some other machines), will not cause any delay, since the cutting current can be employed effectively in a wet field; however, in using a coagulating current (Walker machine) one must have a dry field for the best effect.

## Conclusions

In the 26 cases presented, approximately 40 percent failed to develop a detachment of the retina, 20 percent went on to detachment, and 40 percent were operated upon prophylactically. Of the latter group, at least four more patients quite likely would have developed a detachment had they not undergone operation; therefore, probably upward of 36 percent of the retinas in the entire group would have become detached.

In an eye with a retinal tear, of much more prognostic importance than over-all percentages is the type of tear and the relationship of the vitreous to the flap of the tear and the surrounding retina. If the retinal flap has become entirely separated from the retina and is floating freely about on the posterior face of the vitreous, the chances of a subsequent detachment of the retina from that particular tear are very much lessened; adjacent old chorioretinitis is also a good prognostic sign; it is likely that often (as mentioned by previous authors) the inflammation that initially led to adherence of the vitreous to the retina may have effected a subclinical adhesion of the retina to the choroid. If the retinal flap has not become entirely separated from the tear, constant movement of the eye with the consequent swirling and gyration of the vitreous must continually pull and tug on the flap of retina, tending to lift up the edges of the tear and allow a separation of the retina to develop.

The predisposition of the individual patient must also be brought into mind; if there has been a detachment in the fellow eye, the likelihood of the second eye detaching is great and prophylactic operation should be undertaken.

The presence or absence of vitreous hemorrhage, or of photopsia, has not proved a valuable prognostic sign in our experience. There is no question in our minds as to the significance of these phenomena—a massive vitreous retraction does occasionally occur following a vitreous hemorrhage (Case D); photopsia indicates vitreous pull on attached retina—however, in the cases presented the percentage incidence of these two conditions was equally distributed among the patients who did not suffer detachment and those who did. Therefore, as a prognostic sign in the presence of a retinal tear, these findings cannot be relied upon; in patients who have only a suspected retinal break, they are probably bad prognostic signs, signalling the development of a clinical tear.

The location of the retinal tear is more important if the flap is still attached than if the flap has become a free operculum. A flap above, with attached vitreous pulling and hanging on it, is quite likely to elevate the lips of the tear; whereas, if the tear is below, this result is less likely to occur.

These factors are valuable for prognostic reasons. Probably the safest procedure, however, is to operate all patients with a retinal break, regardless of type or location. Because he has the knowledge that certain conditions may be more or less favorable, the ophthalmologist is in a position to guide the decision of his patient toward prophylactic surgery rather than to temporize.

## Summary

Twenty-six case histories are presented of patients with tears in the retina but without a detachment of the retina. Forty percent of the patients did not develop a detachment, 20 percent of the patients did develop a detachment, and 40 percent underwent prophylactic surgery with successful results. To operate prophylactically is probably the safest course.

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# EXPERIMENTS ON PLEXIGLASS CORNEAL IMPLANTS*

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One of the complications in corneal grafting is the later development of opacities of the transplant. Many different methods for preventing this have been reported in the literature, among which the transplantation of inorganic transparent materials form a small but interesting group.

Nussbaum,[1] more than a hundred years ago, was the first to approach this problem by implanation of a piece of rock crystal. The same material has been used by Weber[2] and von Hippel.[3] Other authors (Heusser,[4] Salzer,[5] Sommer,[6] and Filatov[7]) tried to implant glass. Dimmer[8] reported on similar experiments with celluloid and Wünsche[9] with plexiglass. More recently, experiments with acrylic corneal implants have been described (Györffy,[10] and Stone and Herbert[11]).

## THE PROBLEM

Animal experiments, as well as operations on human eyes, have been rather encouraging, and a few authors (von Hippel, Salzer, and Sommer) have reported the implants being tolerated for a considerable length of time.

The shape of the implants used in these studies was that of a short cylinder with a brimlike projecting disc on one or both ends, resembling a collar button. These bodies were inserted into the cornea after trephining with or without an auxiliary radial incision, or after a keratome incision at the limbus.

In our opinion, the lack of a firm connection between implant and corneal stroma is the reason why most foreign materials could not be kept in place. The ingrowth of epithelium between cornea and implant into the anterior chamber caused permanent fistulation with loosening of the implant.

In order to provide a better junction between cornea and implant and to prevent the ingrowth of corneal epithelium, another type of plastic body and a different surgical procedure were used.

In our experiments, Plexiglass M 33 has been used, out of which a flat cylinder with a polished base and polished upper surface of 2.5-mm. diameter was made. This disclike cylinder measured 1.5 mm. on its rough sides. Near the anterior surface it had a small, circular groove into which a disclike polythene folia of 0.1-mm. thickness and

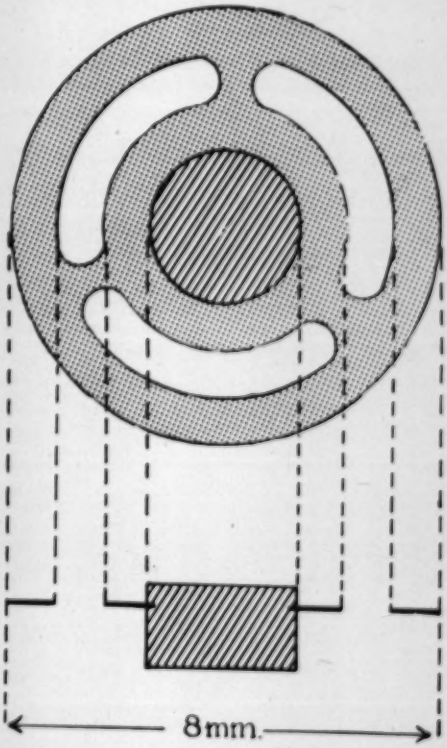


Fig. 1 (Binder and Binder). Schematic drawing of prosthesis.

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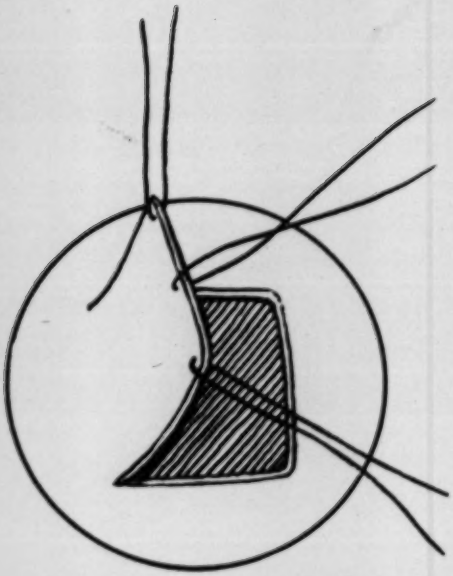

Fig. 2 (Binder and Binder). First surgical step. Separation of the superficial corneal flap with the three auxiliary sutures in place.

8.0-mm. diameter fitted. The drawing (fig. 1) shows the three to four perforations in the periphery of the polythene disc.

## Experiments

The operating procedure was performed in two steps on rabbits' eyes. Preliminary experiments (implantation of small pieces of the materials into the anterior chamber) have shown that both Plexiglass M 33 and polythene are tolerated well for more than a year.

### Step I

To place the "prosthesis," the cornea was split into two lamellae; the thinner superficial one of square shape remained in contact with the deeper corneal layer at its base. To grasp the superficial lamella, three preplaced sutures were used (fig. 2). The deeper part of the cornea was then trephined (2.6 mm. trephine, Figure 3), and the implant inserted, so that the posterior part of the flat cylinder projected somewhat into the anterior chamber, the polythene disc resting on the nontrephined part of the deeper corneal lamella (fig. 4). The superficial flap was then replaced in its natural position and fixed by six to 10 human-hair sutures, thus covering and enclosing the disc and the cylinder between the two lamellae (figs. 5, 6, and 7).

During the following days, the anterior chamber was found to be restored, and the superficial flap edematous, succulent, and opaque. From the limbus many vessels grew into the corneal stroma and into the superficial flap, reaching the center of it after about 20 days. The edema and infiltration of the cornea were then gradually absorbed, and the flap cleared so that the implanted foreign body could be visualized. In most of the cases the irritation due to the operative trauma subsided within the first week and,

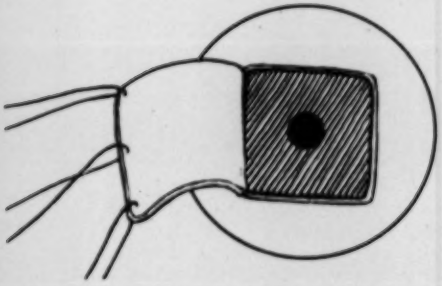

Fig. 3 (Binder and Binder). First surgical step. Trephination of the remaining corneal lamella by means of a 2.6 mm. trephine.

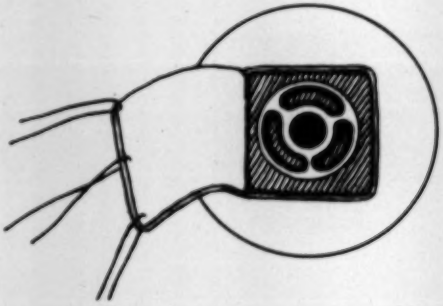

Fig. 4 (Binder and Binder). First surgical step. Prosthesis inserted into trephine hole. The polythene disc resting on the lower corneal lamella.

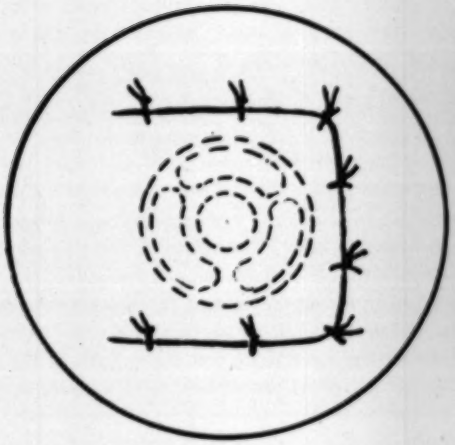

Fig. 5 (Binder and Binder). First surgical step. The superficial flap turned back and resutured; the prosthesis enclosed between the two corneal lamellae.

three weeks later, when the cornea was sufficiently clear for visualization, no signs of iritis were present.

### Step II

Six weeks after the first step of the operation, that part of the cornea which covered the anterior surface of the cylinder was trephined and removed. The prosthesis was now firmly held in position by the enclosed polythene disc, the perforations of which were filled with corneal scar tissue.

Thus the desired stage was reached: the foreign body was firmly healed into the corneal stroma; the polished anterior and posterior surfaces of the cylinder were uncovered, the prosthesis now presenting a clear window (fig. 8). There was now no possibility for epithelial ingrowth.

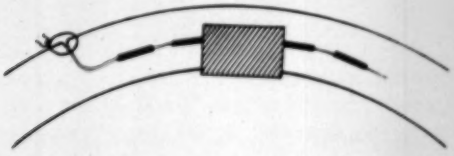

Fig. 6 (Binder and Binder). Cross section through cornea with the prosthesis in situ (schematic).

Fig. 7 (Binder and Binder). Rabbit's eye eight days after the first surgical step. The superficial flap is still covering the prosthesis. There is beginning vascularization of the opacified cornea.

### Results

Twenty-eight rabbits' eyes have been operated upon by the method described.

In six eyes the results have been perfect (fig. 8). These eyes showed no irritation or discharge one week after the second step of surgery, the scleras being pale and the corneal surface smooth, with the exception of slight irregularity at the peripheral margin of the prosthesis.

A few large vessels reached from the limbus to the center of the cornea, the peripheral parts of which were clear, while the

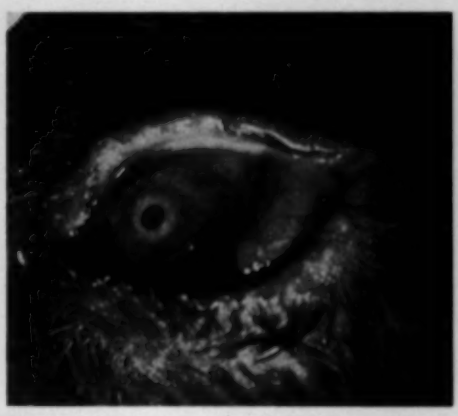

Fig. 8 (Binder and Binder). Rabbit's eye eight weeks after implantation. The superficial flap has been trephined, leaving a clear window.

more central parts were somewhat hazy due to scarification.

Through the plexiglass cylinder a bright red reflex from the fundus could be obtained, although no details of the fundi could be seen, however, due probably to the irregularities in the optical system (the part with the cylinder being highly hypermetropic, as the cylinder had only plane surfaces).

At the slitlamp, several point-shaped grayish deposits on the posterior surface of both cornea and cylinder could be detected but there was no aqueous flare. The irises appeared normal but the pupillary margin in two cases revealed posterior synechias as remnants of a mild iritis. Lens and vitreous were clear.

Between four and five months after the second step of surgery in all six favorable cases a membrane gradually covered the posterior corneal surface obstructing its transparency. Thus the optical results were unsatisfactory in the long run, although the foreign bodies were well tolerated until the natural death of the animals, which occurred in 11 to 27 months following surgery.

Five other experiments were unsuccessful because the superficial flap covering the prosthesis after the first step of the procedure was too thin and was penetrated within the first few postoperative days by the edges of the prosthesis. Blinking then pushed the prosthesis forward, resulting finally in its loss.

In 12 other cases the six-week period after the first surgical step seemed to be satisfactory. When the second step was performed, however, one could see that the posterior surface of the cylinder was already covered by an opaque, grayish-white membrane. In nine of these animals the eyes remained quiet, while in three other cases the plexiglass cylinder was gradually pushed forward, in our opinion due to a shrinkage of this "retrocorneal" membrane. The projecting part was mobilized by lid motion and ultimately the prosthesis fell out.

In the remaining five experiments, a secondary glaucoma developed shortly after the first surgical step, followed by extrusion of the prosthesis.

## Discussion

Difficulties with the superficial flap can be prevented with some skill and care but the main problem is, in our opinion, the formation of a fibrous tissue membrane behind the foreign body. The stimulus for this connective-tissue formation may be either mechanical irritation caused by the otherwise well-tolerated inorganic material; or some microscopic remnants of the polishing material (oxide of aluminum) which could not be removed from the surface of the cylinder even by the most careful precautions. Attempts to cut this membrane off by needling knives had only transitory success and, after a few days, the membrane was reformed.

Since these connective-tissue membranes form following a preceding exudation of fibrin, streptokinase was injected in small doses into the anterior chamber of those eyes developing the first signs of a beginning membrane formation. As long as streptokinase was applied, the development of the membrane was prevented but, as soon as it was discontinued, membrane formation began again. In other cases, cortisone was administered locally together with streptokinase, also without favorable results of lasting character.

The results shown are, in our opinion, encouraging enough to justify the use of the same surgical procedure in combination with other inorganic transparent materials (the best of which seems to be methyl-metacrylate, Stone and Herbert[11]) or in combination with other fibrinolytic substances.

## Summary

A new surgical technique for carrying out corneal transplantation in rabbits with inorganic material (Plexiglass M 33 and polythene) is described. Results have been sufficiently encouraging to warrant further studies.

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# COLOR VISION IN NATIVE RACES IN AUSTRALASIA


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In the course of three surveys so far undertaken in Australasia to determine the incidence of various types of eye disease, the opportunity was taken to try out the use of the Ishihara color test on native races. Our knowledge of the occurrence of color defect among races other than European is still somewhat scanty and in the past 60 years very little work appears to have been done in this field.

In the early part of the century there seems to have been a vague belief that the more "primitive" races had less well-developed color vision than the so-called civilized races and that many pigmented peoples had an insensitivity to blue. This belief is probably based on old fallacious notions of an increasingly adequate color discrimination becoming developed as one climbs up the phylogenetic tree. Since we now know that man is nowhere near the top of this tree in specialization, and that color vision appears at intervals throughout the taxonomic scale, beginning certainly in the Teleostean fishes and possibly in the Holosteans (Walls) there is no argument left for the belief that the more primitive a race, or indeed a species, the less its power of hue discrimination.

On investigation, the idea just referred to, that primitive races have little sensitivity to blue, is seen to be founded on arguments derived from a study of language and color nomenclature rather than actual power of discrimination.

Around the beginning of the century W. H. R. Rivers investigated color vision in various races, including natives of Upper Egypt, the Todas of the Nilgiri Hills, and the Papuans of the Torres Straits Islands. He used Holmgren's wools, Naegel's cards (circles of colored dots), and the Lovibond tintometer. He also made a study of color nomenclature. He found that in matching tests (for example Holmgren's) greater importance was attached by native races to saturation rather than color tone, but this did not prove that the hue differences were not also perceived. When the language of color was studied, it was usually found to be very deficient, colors having few names of

their own but being called by the names of objects or texture which they recalled. Among the natives of Upper Egypt, for example, there is a word for red but the word usually used for yellow may be applied also to green, light brown, and faint red. It therefore probably means "light colored." The word for milk is also used for light colors and for blue. The word for green may be applied equally to all darkish colors other than red and yellow. There is no definite word for blue or brown. This holds good also for the Papuans of the Torres Straits Islands. Some races have adopted the English word blue (as buloo or bulu bulu), which they then apply correctly. Defect of color language cannot be taken to imply defect of color sense, since once a color name has been learned it can always be used accurately.

Rivers considered that the use of Holmgren's wools did not give an accurate result because natives often match for brightness rather than hue. He found 4.5 percent of the natives of Upper Egypt were red-green blind, but among the Todas of the Nilgiri Hills as many as 10 percent were color defective. These people were divided into two distinct endogamous groups and one group showed a higher incidence of red-green blindness than the other. This might well occur owing to the hereditary nature of the defect, which would be intensified by inbreeding. We shall find evidence later that this can also occur among the inhabitants of remote South Pacific Islands. Rivers' findings among the Papuans of the Torres Straits were very different from the figures for the Todas and the Egyptians, in that of 152 male Papuans examined not one was red-green blind. He places the Todas and the Egyptians as having the highest incidence (he thinks even higher than the British) and the Papuans as being entirely free of the defect.

Very little work was done on the subject until recently, when Geddes, in 1946, and Simon, in 1951, investigated the color vision of Fijians and Buganda Africans. Geddes considered that matching tests did not give accurate results so he employed the Ishihara tests, the figures being spoken (or traced with the finger in the case of the illiterates) and no naming of colors used. Geddes tested both Fijians and Indians resident in Fiji. He gives the figures for Fijian males as shown in Table 1.

TABLE 1

GEDDES' FIGURES FOR FIJIAN MALES

| Age (yr.) | Tested | Red-Green Blind | Percent |
|---|---|---|---|
| 18–35 | 387 | 2 | 0.5 |
| 6–14 | 221 | 3 | 1.4 |
| TOTAL | 608 | 5 | 0.8 |

No females out of 99 tested were found with red-green blindness. In addition 200 Fijian recruits were examined by the officer commanding the New Zealand Optical Unit in Suva and no case of color defect was found.

Among Indians resident in Fiji but with no Fijian blood he found 12 males of 148 examined who were red-green blind (8.1 percent). No Indian females were tested.

Geddes also quotes various papers on color vision in white persons, American Negroes, and American Indians, the results of which he summarizes, as shown in Table 2.

Simon in 1951 worked with Buganda Africans in Uganda. He used the Ishihara test,

TABLE 2

GEDDES' FIGURES FOR WHITES, AMERICAN NEGROES AND AMERICAN INDIANS

| | Investigator | No. | No. of Color Blind | Percent |
|---|---|---|---|---|
| White | Von Planta | 2,000 | 159 | 7.95 |
| White | Miles | 1,286 | 106 | 8.24 |
| White | Haupt | 448 | 35 | 7.81 |
| American Indian | Clements | 624 | 12 | 1.92 |
| American Negro | Clements | 323 | 12 | 3.71 |

TABLE 3

WHITE MALES INVESTIGATED IN PRESENT STUDY

| Place | No. Examined | No. Defective | Percent |
|---|---|---|---|
| Kimberley Division | 207 | 25 | 12.07 |
| Eastern Goldfields | 296 | 12 | 4.05 |
| Papua | 55 | 4 | 7.2 |
| TOTAL | 558 | 41 | 7.3 |

and also investigated color nomenclature, which he found vague though color discrimination was excellent. He examined 537 Buganda males and found 1.86 percent were red-green blind. He concluded, therefore, that color sense in Africans cannot be correlated with color terminology and that confusion of colors in matching tests is due to the fact that brightness and saturation is psychologically more important to primitive man than tone or hue.

We therefore thought it of interest to analyze our results among Australians (both white and aboriginal) and natives of Papua and New Guinea.

Some groups of white Australians showed a higher percentage than that usually given for Europeans. Of 207 white males tested in the Kimberly Division, 25 or 12.07 percent were color defective, but of 296 examined in the Eastern Goldfields only 12 (4.05 percent) were defective. Indeed the figures for the cases investigated in Australasia are somewhat different in the three regions (tables 3, 4, and 5).

A possible explanation for the 12 percent found among the white persons in the Kimberly area lies in the fact that a large number

TABLE 4

WHITE FEMALES INVESTIGATED IN PRESENT STUDY

| Place | No. Examined | No. Defective | Percent |
|---|---|---|---|
| Kimberley Division | 67 | 1 | 1.49 |
| Eastern Goldfields | 240 | 1 | 0.42 |
| Papua | 20 | — | — |
| TOTAL | 327 | 2 | 0.61 |

TABLE 5

HALF-CASTES INVESTIGATED IN PRESENT STUDY

| Place | No. Examined | No. Defective | Percent |
|---|---|---|---|
| *Colored males* | | | |
| Kimberley Division | 86 | 2 | 2.32 |
| Eastern Goldfields | 74 | 2 | 2.07 |
| Papua | 21 | 2 | 9.5 |
| TOTAL | 181 | 6 | 3.2 |
| *Colored females* | | | |
| Kimberley Division | 56 | — | — |
| Eastern Goldfields | 71 | — | — |
| Papuans | 146 | — | — |
| TOTAL | 173 | — | — |

of those tested were the employees of the Australian Iron and Steel Company at the iron ore project of Cockatoo Island. For employment here there is no color vision test (except for the electricians, of whom there are few) and the pay is high and conditions of work good. In the South and East of Western Australia the higher paid jobs open to ambitious young men (electrician, plumber, railway worker, airman, sailor, and so forth), carry a color vision test for apprenticeship. It therefore seems quite possible that color-blind men, debarred from this type of employment in the South, tend to seek their fortunes in the North and gravitate toward the A.I.S. Company on account of its good prospects. All the employees of this company were tested and formed a large part of the white males investigated in the Kimberleys. We cannot think of any other theory to account for the 12 percent incidence in this area as against the 4.15 percent of the Eastern Goldfields.

The figure of 0.61 percent in Table 4 is higher than would be expected but may be misleading as only 327 white females were examined. Both the male and female incidence of color defect in the Australian white population is somewhat higher than was anticipated, a survey in Oxford (carried out on 6,064 school children by Dr. Warin) hav-

ing shown only 3.1 percent of boys and 0.07 percent of girls to be color defective.

The half-caste colored population in the Kimberleys, the Eastern Goldfields, and Papua gave the results in Table 5. The colored population as a whole seems to have better color vision than the white. The full-blood aboriginal populations in the same region gave even better results, only 1.9 percent being color defective (table 6).

Thus we see that the color vision of the aboriginal populations of Australasia is good and that there is no ground for supposing ipso facto that the more primitive races are the more color deficient, in spite of the fact that isolated groups such as the Todas may show a high incidence of the defect.

One possible reason for the high incidence in isolated groups is inbreeding and this is borne out by some of the figures from Papua. For instance, in the Marshall Bennett Islands, which are but little subject to outside contacts and have never been habited by Europeans, 268 full blood males and 211 females were examined. Eleven males and one female were color defective (4.1 percent males; 0.4 percent females). These two small islands show a higher incidence than that of all Papua where no other color-blind female was found and where the total male color defect is 2.02 percent. Other small pockets of high incidence were found, consistent with the known genetic basis of the condition. For example, in Losuiya (Trobriand Islands) eight males in 123 examined were color defective (6.5 percent) but in two only of the remaining 28 villages examined were any cases found at all, 375 consecutive examinations in 26 villages being negative.

TABLE 6

ABORIGINALS TESTED IN PRESENT STUDY

| Place | No. Examined | No. Defective | Percent |
|---|---|---|---|
| *Aboriginal males tested* | | | |
| Kimberley Division | 171 | 4 | 2.33 |
| Eastern Goldfields | 207 | 2 | 0.97 |
| Papua | 4,077 | 82 | 2.01 |
| TOTAL | 4,455 | 88 | 1.9 |
| *Aboriginal females tested* | | | |
| Kimberley Division | 115 | — | — |
| Eastern Goldfields | 120 | — | — |
| Papua | 2,966 | 1 | 0.0337 |
| TOTAL | 3,201 | 1 | 0.0312 |

Sometimes an island would appear to be entirely free of the defect. For example, on Woodlark Island no case was found in the four villages examined.

## SUMMARY

Thus we see that among the white Australian males tested with the Ishihara test, 7.3 percent have defective color vision, and among white Australian females 0.61 percent show the same thing.

The colored population is better, with 3.2 percent males and no females. The aboriginal populations taken together give 1.9 percent for males and 0.031 percent for females. The aboriginal figures are probably more accurate as much larger numbers were tested.

There is therefore no ground for supposing that primitive races have less good color vision than people of European stock. On the contrary, their color vision is likely to be much better, except in the case of the Indians and the Todas.

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# BOWEN'S DISEASE (INTRAEPITHELIAL EPITHELIOMA) OF THE CORNEA AND CONJUNCTIVA*

## A CLINICOPATHOLOGIC STUDY

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Bowen's disease or intraepithelial epithelioma was first described, as occurring in the skin, by Bowen,[1] in 1912. In 1921, the condition was described by Jessner[2] in a mucous membrane. It was not until 1942, however, that Bowen's disease of the cornea and conjunctiva was reported by McGavic.[3] He reported five cases from the Institute of Ophthalmology, Presbyterian Hospital, New York, and the following year a sixth case from the same institution was recorded by Wise.[4] Since then, a number of cases have been reported by other authors.[5–16]

This paper is a study of 12 additional cases† from the Institute of Ophthalmology, Presbyterian Hospital, New York, plus a follow-up study of the five cases previously reported by McGavic[3] and the one by Wise.[4] Cases appearing at the institute since 1951 are not included. In analyzing the pathologic and clinical characteristics of this series, the 18 cases will be considered together.

### HISTOPATHOLOGY

A positive diagnosis of Bowen's disease can only be made under the microscope. Figures 1 to 6 illustrate the histopathology of the lesion, as seen in our cases. The most important characteristic of the disease is that the hyperplasia that occurs is entirely intraepithelial. The basal cells may proliferate and form pegs (as in fig. 1) but the basement membrane remains intact and no true invasion is seen. Figures 2 and 3 show rather advanced cases but it can be seen that the tumor is spreading by lateral extension rather than by subepithelial invasion. As a contrast, Figure 7 shows a squamous-cell carcinoma of the conjunctiva, where the tumor is invading the deeper tissues in the form of interlacing strands and bundles.

The lesion characteristically has an abrupt commencement, as seen in Figure 1. A marked subepithelial inflammatory infiltration, with lymphocytes and plasma cells (figs. 4 and 5) sometimes accompanied by increased vascularity (fig. 4), is the rule. That this is more pronounced than in the more malignant squamous-cell carcinomas is said to be due to the fact that "tissue invaded by carcinomatous cells is able to defend itself to some extent, provided the cells are only moderately malignant, but is overwhelmed without a fight if the cells are highly malignant."[17]

Figures 4, 5, and 6 show the cytologic characteristics of the lesion under higher power. The cells show marked variations in size, shape, and staining properties and a disordered polarity. The term "poikilokarynosis" has been coined to describe this cellular variation and unrest peculiar to Bowen's disease. Monster cells occur which are of two types: first, cells containing a single very large nucleus (figs. 5 and 6) and, second, cells containing multiple nuclei clumped together, the so-called "clumped cells of Bowen." Vacuolation of the cells is common. There is a marked tendency toward hyperchromasia of the nuclei, with a prevalence of mitotic figures and some abnormal mitotic figures.

Bowen's disease is most often looked upon as precancerous lesions, although controversy exists as to whether they should not

* From the Institute of Ophthalmology of the Presbyterian Hospital, New York. Presented at the 18th annual meeting of the Canadian Ophthalmological Society, Bigwin Inn, Muskoka, Ontario, June, 1955.

† The histopathologic diagnoses in these cases were confirmed by Dr. A. B. Reese and Dr. A. P. Stout.

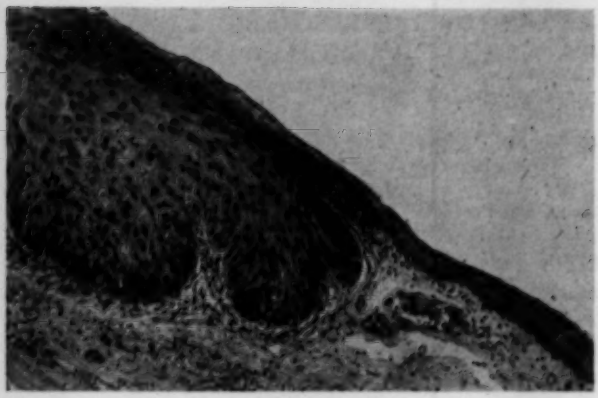

Fig. 1 (Locke). Microscopic section, showing abrupt commencement of a Bowen epithelioma of the cornea. The basal cells are proliferating to form pegs but the basement membrane remains intact.

be looked upon as being frank carcinoma from their onset.

In any event, it is apparent that several of the cytologic characteristics of a Bowen epithelioma are in the direction of dedifferentiation or atypicality of the cells. Therefore, if and when the lesion does become invasive, it immediately becomes a Grade II or Grade III squamous-cell carcinoma, rather than a less malignant type.[18]

### Clinical appearance

The clinical appearance of ocular Bowen's disease has been well described by McGavic[8] and by Reese.[19] The lesions are elevated (fig. 8). They are usually single but may be multiple. They are gray to reddish gray in color depending on the vascularity, which may be considerable.

They are usually fed by large, dilated vessels, and slitlamp examination may show numerous minute capillaries running perpendicular to the surface. The surface is irregular and can be described as being "cauliflowerlike" or "gelatinous." They have a sharply demarcated border.

In the early stages, they are most frequently mistaken for pterygia and several of the cases in this series were first diagnosed as such. A careful slitlamp examination should make the differentiation possible. Differentiation from squamous-cell carcinoma is more difficult and only possible with finality under the microscope. Reese[19] has

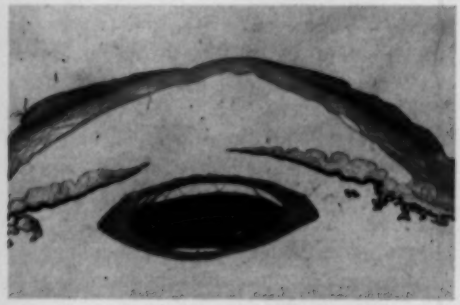

Fig. 2 (Locke). Microscopic section in an advanced case of Bowen's disease of the cornea. No invasion is seen. The tumor is spreading by lateral extension (McGavic[8]).

Fig. 3 (Locke). Microscopic section in an advanced case of Bowen's disease of the cornea and conjunctiva. The tumor later spread to the nasolacrimal sac of the same side and assumed malignant characteristics.

Fig. 4 (Locke). Microscopic section in a case of Bowen's disease of the cornea, showing subepithelial inflammatory infiltration accompanied by increased vascularity.

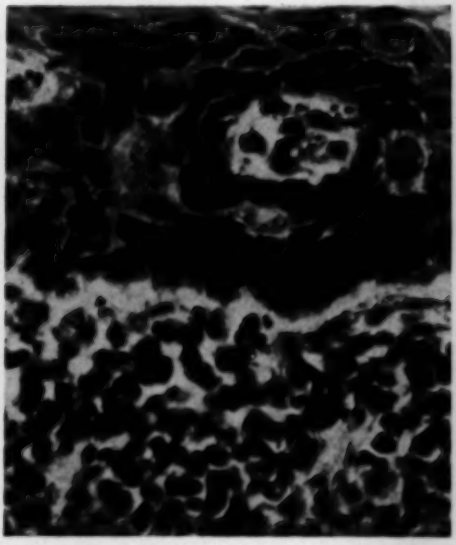

Fig. 5 (Locke). Microscopic section of a portion of a Bowen epithelioma of the cornea under high power, showing monster cells and subepithelial inflammatory infiltration.

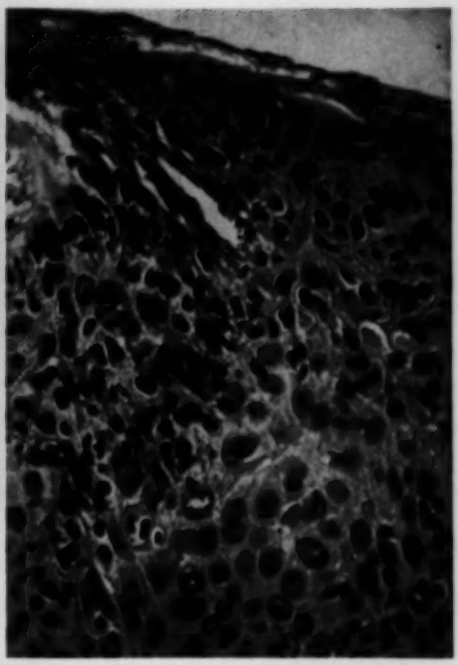

Fig. 6 (Locke). Microscopic section of a portion of a Bowen epithelioma of the cornea under high power, showing disordered polarity of the cells and marked variation in their size, shape, and staining properties.

pointed out that clinically the latter has a more striking pearly-white color. Other epibulbar lesions requiring differentiation are papilloma, epithelial plaques, dermoid, nevus, lymphoma, fibroma, corneal pannus, leukoplakia, and Mooren's ulcer.

## Analysis of cases

The average age of the patients in the 18 cases considered here was 62 years, the mean age was 63 years, and the youngest patient was 40 years. Although the literature shows a preponderance of the disease among males,[10] our cases were evenly divided between males and females. All our cases were unilateral, although a bilateral case is recorded in the literature.

In six of the cases, the lesions had their original at the site of pre-existing corneal dis-

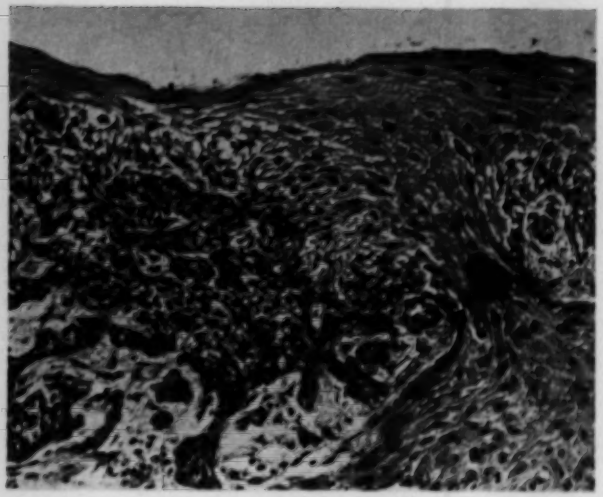

Fig. 7 (Locke). Microscopic section of a case of squamous-cell carcinoma of the conjunctiva, showing subepithelial invasion by the tumor cells.

ease. (One of McGavic's cases arose in an old trachomatous pannus; others in this series arose from corneal scars or ulcers, secondary to burns and other injuries.) The remainder originated in previously healthy tissue: 10 from the limbus and two from the bulbar conjunctiva. The well-known predilection of epibulbar epitheliomas for the palpebral aperture[19, 20, 21] (suggesting the etiologic role of irritation) was also apparent here.

Two of the patients had had psoriasis and had received treatment with arsenic, a well-recognized carcinogenic agent. Its etiologic association with various types of epitheliomas, including Bowen's disease, has frequently been reported,[1, 22-27] but not to my knowledge in connection with Bowen's disease of the eye.

Fig. 8 (Locke). Case of Bowen's disease of the cornea and conjunctiva arising at the limbus, showing large dilated conjunctival blood vessels.

Five of the 18 cases had other precancerous lesions of the skin and mucous membranes, and four of these five patients also had another associated primary malignancy:

1. A case with cancer of the stomach.
2. A case with oligodendroma of the brain.
3. A carcinoma of cyst-gland origin of the upper lid of the same eye.
4. Paget's disease of the breast.

These patients may have a predisposition to malignant and premalignant disease. Multiple malignant tumors of a single organ, such as the skin or large intestine, are not uncommon,[28, 29] but it is generally agreed that metachronous cancers in different organs are rare. The difficulties in studying this problem can be appreciated when it is known that in a large statistical study of multiple malignant growths, Lombard and his colleagues[29] found that, in approximately half the individuals with multiple cancers other than skin, the second primary cancer

was not discovered until death. While nothing can be inferred from such a small series of cases as is reported here, it would be of interest to follow cases of epilbulbar epitheliomas over a long period of time.

The literature on malignant manifestations of Bowen's disease has been reviewed by Stout.[30] In our series, malignant change took place in three of the 18 cases:

1. *Squamous-cell epithelioma arising from a portion of the ocular lesion* (McGavic's Case 4[3]):

Abstract of case report:[3] N. R., a white female, presented herself at the clinic because of bleeding from the right eye. She had noted a tumor mass on the eye for less than two years. Examination showed a large, fleshy, firm mass adherent to the upper part of the cornea and adjacent structures. There were a great number of tiny capillaries on the surface of the tumor, and blood was coming from these vessels.

Microscopic report: The corneal epithelium showed the characteristics of mucosal Bowen's disease with a transition into squamous-cell epithelioma at one margin. As one approached one side of the cornea, the proliferation became more active with a higher mitotic rate, and the tumor gradually invaded the bulbar conjunctiva and assumed the characteristics of an ordinary well-differentiated squamous-cell epithelioma.

Follow-up study: Communication with this patient's referring physician revealed that she died three months after the enucleation, of acute liver disease, non-neoplastic in origin and unrelated to her eye condition.

2. *Malignant change associated with spread to the nasolacrimal sac of the same side (figs. 9 to 12):*

Case report: The patient, J. C. (Unit No. 909962), a 71-year-old white man, a school janitor, was first seen in 1943. An elevated uneven fleshy mass, measuring about four mm. in diameter, was present on the bulbar conjunctiva of the left eye. He was advised to have the tumor removed, but failed to return until May 5, 1948. An elevated gelatinous lesion now extended over the entire cornea and much of the bulbar conjunctiva into the lower cul-de-sac (figure 9). On May 14, 1948, the left eye was enucleated, and the entire conjunctiva was excised and replaced with a Thiersch graft.

Microscopic report: The corneal and conjunctival neoplasm is typical of intra-epithelial epithelioma (figure 3). There is considerable thickening of the epithelial layers. There is an inflammatory reaction on the under surface of the epithelium. The cells are edematous and in some places vacuolated; they have lost their normal polarity and in some places have taken on bizarre shapes. Numerous mitotic figures are apparent. In some areas, multinucleated giant type cells may be seen. Bowman's membrane is ruptured in several places, but this seems secondary to the inflammatory reaction rather than to an invasion by the tumor. Pathologic diagnosis: Bowen's disease.

Fig. 9 (Locke). Advanced case of Bowen epithelioma of the cornea and conjunctiva. The lesions extend over the entire cornea and much of the bulbar conjunctiva.

While in hospital, an advanced gastric carcinoma was discovered. Total gastrectomy was performed. Pathologic diagnosis was: Carcinoma of the stomach with metastasis to the superior gastric lymph glands.

The patient again disappeared and was not seen for 17 months. He now showed a large firm irregular mass in the region of the left nasolacrimal sac, measuring two cm. in diameter (fig. 10), which he had first noticed four months previously

Fig. 10 (Locke). Squamous-cell carcinoma of the left nasolacrimal sac, secondary to Bowen epithelioma of the cornea and conjunctiva of the left eye. Eschar in orbit. No orbital recurrence. The left eye had been enucleated 17 months previously, and the entire conjunctiva excised and replaced with a Thiersch graft.

Fig. 11 (Locke). Senile keratoses involving the helix of the ear in a patient with Bowen's disease of the cornea and conjunctiva and carcinoma of the stomach.

and which had gradually been growing in size. No bony invasion was seen by X ray. Skin lesions present on the ears, cheek, lips, and hands were diagnosed by the Dermatology Department as senile keratoses (fig. 11). Another skin lesion present on the right hip was thought by the dermatologists to be an epithelioma of the Bowen type.

A large portion of the mass in the left nasolacrimal sac region was removed for biopsy, the same week. Pathologic examination showed a squamous-cell carcinoma (fig. 12), which in the opinion of the pathologist, Dr. A. P. Stout, "had undoubtedly resulted from incomplete removal of the conjunctival and corneal epithelioma." The nasolacrimal sac lesion was then treated with X-ray therapy and a good immediate resulted obtained.

Secondary carcinoma of the nasolacrimal sac most commonly occurs either as an extension of an epithelioma of the lower lid or palpebral conjunctiva,[31] or secondary to carcinoma of the adjacent nasal or sinus mucosa.[31, 32] Carcinoma of the nasolacrimal sac secondary to an epibulbar epithelioma is almost unknown. The association of a second

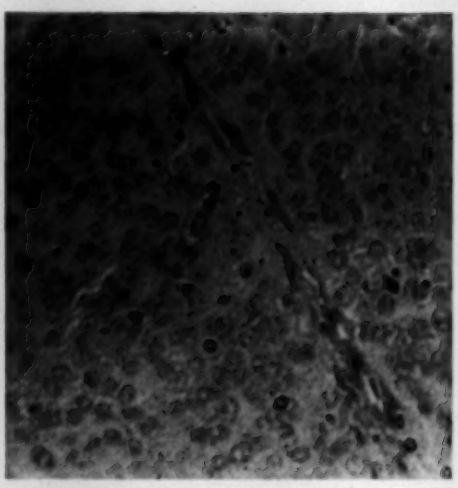

Fig. 12 (Locke). Microscopic section, showing squamous-cell carcinoma of nasolacrimal sac, secondary to Bowen's epithelioma of the conjunctiva.

primary malignancy in the stomach and of multiple precancerous lesions of the skin were other unusual features of interest in this case.

3. *Metastasis to the parotid gland of the same side:*

Case report: M. W. (Unit No. 697843), a 65-year-old white man, was first seen January 11, 1943, with an elevated lesion of the left bulbar conjunctiva of five years' duration, located nasal to the cornea and involving the caruncle. Biopsy on January 12, 1943, showed a Bowen's epithelioma of the conjunctiva, with no evidence of local invasion. The lesion was treated with X-rays with satisfactory local regression. In December, 1946, a nodule was observed in the left preauricular region. Microscopic examination of the nodule after its removal showed squamous-cell carcinoma, which was thought to be metastatic from the Bowen's disease of the conjunctiva.

This is an example of a case which metastasized without demonstrable evidence of local violation of the basement membrane. Stout[30] reports a similar case of Bowen's disease of the floor of the mouth, which metastasized to the neighboring lymph glands. He feels that one of the important features of the true Bowen epithelioma is "the occurrence of metastasis with a minimal amount of local penetration which may defy

clinical detection and even escape ordinary microscopic study, so that only serial sectioning of the entire lesion will reveal it."

### Results of follow-up study of previously reported cases

McGavic's Case 1[3] (A. A., Unit No. 513.556) gave results of interest:

Abstract of case report: This was a patient in whom the epithelioma had had its origin in an old trachomatous pannus and which, at the time of the first treatment, not only covered the upper third of the cornea of the right eye but also involved the upper bulbar and palpebral conjunctiva. The corneal portion of the lesion had been excised in 1939, but, because of its diffuse extent, surgical excision of the remainder of the lesion was not considered feasible. Accordingly, border ray therapy was given, a total of 800 r units being delivered, the portals being directed at two areas above the cornea to either side of the midline. Technical difficulties prevented treating the entire extent of the conjunctival tumor.

Follow-up study: In May, 1943, because of a suspected recurrence, X-ray treatment to the entire globe was tried. A total dose of 300 r measured in air over the entire left eye was given in 10 sittings. In July, 1943, it became necessary to enucleate the globe, because of severe pain due to keratitis and secondary glaucoma resulting from the X-ray therapy. Pathologic examination of the globe showed a tremendous amount of fibrous tissue at the limbus, but no evidence of epithelioma.

Examination of the patient revealed other precancerous lesions, namely: leukoplakia of the vulva and arsenical keratoses of the palms and soles. In April, 1944, a brain tumor was diagnosed and removed, the pathologic diagnosis of which was: "Oligodendroglioma with astrocytic elements."

Further study of McGavic's remaining cases did not bring to light any evidence of recurrence, metastasis, or other associated cancerous or precancerous lesions. (One case was lost to follow-up. Two patients died of unrelated illnesses, two months and four years, respectively, after their enucleations. The final patient was alive and well, with no recurrences, after four years.)

The results of the follow-up study of the case reported by Wise[4] (J. M., Unit No. 672.987) are of interest because it illustrates the satisfactory result that can be obtained by simple excision of a diffuse lesion, which, while covering the entire cornea, involved only that portion of the bulbar conjunctiva immediately adjacent to the limbus.

Abstract of case report: Three distinct small fleshy masses at the 3-, 12-, and 9-o'clock positions on the limbus could be seen. The cornea was covered by an opaque, uneven, thickened tissue connected to each limbal lesion. Vision in the affected eye before operation was light projection. In April, 1942, the tumor was peeled away from the cornea and sclera by a superficial keratectomy. The conjunctiva was undermined and brought up to the limbus to close the defect.

Follow-up study: Examination, six and one-half years later, in November, 1948, showed a diffuse cloudiness of the cornea but no recurrence, and the visual acuity was now 20/70.

### Results of treatment

#### Treatment by excision

The prognosis was good when the epithelioma was confined to the cornea or limbal region, and treatment of these cases by simple excision was effective, safe, and technically not difficult. Of 10 such cases treated by excision, three had a recurrence, but reoperations were then successful in every instance.

While some authors select radiotherapy as the initial treatment,[8, 11] and good results with this therapy have been reported,[8, 11] the results of treatment in the present series support the efficacy and simplicity of surgical excision. The neoplasm peels away easily from the underlying Bowman's membrane and the eye is spared the danger of late radiation effects [33, 34] on the one hand, and the danger of local spread, malignant change, or metastasis, on the other.[30]

A satisfactory technique of excising these and other similar lesions has been described by Reese.[35] We found that recurrence did not occur if care was taken to remove one mm. of normal epithelium adjacent to and surrounding the lesion. When a lesion did recur, the second excision was no more difficult than the first.

#### Treatment by enucleation and exenteration

Enucleation was considered necessary in five cases, because of their severity. One

of these patients was lost to follow-up study, and another died of an unrelated illness within two months of the eye operation. One patient was alive and well four years after enucleation; another patient died of cardiac disease after two years, but with no evidence of recurrence or metastasis; and the final patient, while showing no orbital recurrence after three years, developed carcinoma of the nasolacrimal sac, apparently due to direct spread from the conjunctival lesion.

### Treatment by irradiation

Our series does not permit a comparison of the results of excision versus X-ray therapy in the case of the localized lesions, or of the results of enucleation versus X-ray therapy in the case of the advanced lesions. One of the 10 cases successfully treated by excision had previously received radiotherapy without success at another institution, but no details of the dosage are known. The two others in our series who received treatment with X rays were advanced cases in which a large portion of the bulbar conjunctiva was diffusely involved. As already described, while the ocular growth was successfully destroyed in both cases, metastasis to the parotid gland occurred in one, and, in the second, enucleation became necessary because of iridocyclitis and secondary glaucoma resulting from the therapy.

In the case of the early lesions and those localized to the cornea or limbal region, the good results obtained here by simple excision leave us with no doubt that this is the treatment of choice. In very advanced cases, where it is certain that local excision will be inadequate, enucleation (or exenteration if indicated) offers the patient the best hope of avoiding local spread and metastasis.

### Summary

1. Eighteen cases of Bowen's disease of the cornea and conjunctiva have been discussed, six of which represent follow-up studies of previously reported cases.

2. The average age was 62 years, the mean age was 63 years, and the youngest patient was 40 years. The cases were evenly divided between males and females.

3. In six of the cases, the lesions had their origin in the cornea at the site of preexisting disease. The remainder originated in previously healthy tissue: 10 from the limbus and two from the bulbar conjunctiva.

4. Two of the patients had psoriasis for which they had received treatment with arsenic.

5. Five of the 18 cases had other precancerous lesions of the skin and mucous membranes, and four of these five patients had another associated primary malignancy.

6. Malignant change took place in three of the 18 cases: (a) A transition to squamous-cell carcinoma observed in a portion of the ocular lesion itself; (b) associated with direct spread to the nasolacrimal sac; and (c) metastasis to the parotid gland of the same side.

7. Simple excision was found to be a satisfactory method of treatment except where extensive involvement made enucleation necessary.

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### Acknowledgement

I am greatly indebted to Dr. Algernon B. Reese who made the initial clinical and pathologic diagnoses in many of these cases.

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# A NOTE ON THE DISTRIBUTION OF SODIUM BETWEEN PLASMA AND AQUEOUS HUMOR*

## WITH SPECIAL REFERENCE TO THE MONKEY

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The distribution of sodium between plasma and aqueous humor is of considerable theoretical interest, since this ion—together with its oppositely charged anions—constitutes some 90 percent of the total osmolar activity of the fluids; consequently, quite small deviations of the distribution from the equilibrium value will be attended by relatively large differences of osmotic pressure, leading to an influx or efflux of water into, or out of, the eye fluids.

Earlier work has shown that the distribution of sodium between plasma and aqueous

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humor differs from the equilibrium distribution in that there is an excess of sodium in the aqueous humor; this is true of the cat and dog (Davson, Duke-Elder, and Maurice[1]), the guinea pig (Scholz[2]; Davson[3]), and the horse (Davson[3]). Only in one of the species examined, namely the monkey, has the reverse been reported, Scholz[2] having found a value of 0.87 for the distribution-ratio: concentration in aqueous humor/concentration in plasma-water, comparing with a true equilibrium distribution-ratio, between plasma and its dialysate, of about 0.95.

This finding, if it could be confirmed, would be of great interest, since it suggests that the monkey's aqueous humor is strongly hypotonic to the plasma. It was therefore considered worthwhile repeating Scholz's study; since the distribution of sodium between plasma and cerebrospinal fluid has not hitherto been measured in the monkey, the latter fluid was examined in addition to the aqueous humor. The results, to be described later, show that the monkey does not differ markedly from the other species, so far as the distribution of sodium between plasma, aqueous humor, and cerebrospinal fluid is concerned.

## Methods

Monkeys (Cercopithecus aethiops; Erythrocebus sp.) were injected with about one mc. of $Na^{24}$ in the form of an isotonic solution of a mixture of the chloride and bicarbonate, made by neutralizing irradiated sodium carbonate with HCl. After an appropriate interval they were anesthetized with Nembutal, and blood, aqueous humor, and cerebrospinal fluid were removed, the last by cisternal puncture. Plasma and the other two fluids were counted for radiactivity in a liquid G.M. counter, and the usual corrections for decay, resolving time and background were made when necessary.

## Results

The distribution of $Na^{24}$ between the fluids is shown in Table 1, where the distribution is expressed as the ratio, R, given by the concentration in fluid/concentration in plasma-water. It will be seen that, when 48 hours are allowed for the injected isotope to come into equilibrium with the aqueous humor, the value of $R_{Aq}$ lies between 0.93 and 0.995, with a mean of 0.97; this value falls within the range of values found for other species summarized in Table 2. If only 24 hours are allowed for equilibration, however, values for the distribution-ratio may be found that are definitely very low—0.87 and 0.89—and they are comparable with those reported by Scholz. It will be noted that the distribution-ratio for the cerebrospinal fluid —$R_{Csf}$—is always greater than that for the aqueous humor; this means that the cerebrospinal fluid has the greater concentration

TABLE 1

DISTRIBUTION OF $Na^{24}$ BETWEEN PLASMA AND AQUEOUS HUMOR ($R_{Aq}$) AND PLASMA AND CEREBROSPINAL FLUID ($R_{Csf}$) IN THE MONKEY

| Monkey | Time after Injection (hr.) | $R_{Aq}$ | $R_{Csf}$ |
|---|---|---|---|
| 1 | 24 | 0.87 | 0.99 |
| 2 | 24 | 0.89 | 0.995 |
| 3 | 24 | 1.005 | 1.065 |
| 4 | 48 | 0.99 | 1.03 |
| 5 | 48 | 0.995 | 1.005 |
| 6 | 48 | — | 1.03 |
| 7 | 48 | 0.93 | 0.98 |
| 8 | 48 | 0.98 | 1.00 |
| 9 | 48 | 0.975 | 0.98 |

TABLE 2

DISTRIBUTION OF SODIUM BETWEEN AQUEOUS HUMOR AND PLASMA ($R_{Aq}$) AND CEREBROSPINAL FLUID AND PLASMA ($R_{Csf}$) IN DIFFERENT SPECIES

| Species | $R_{Aq}$ | $R_{Csf}$ | $R_{Dial}$* |
|---|---|---|---|
| Horse | 0.935 | 0.97 | 0.925 |
| Ox | 0.94 | — | — |
| Sheep | 0.94 | — | — |
| Goat | 0.93 | — | — |
| Pig | 0.93 | — | — |
| Monkey | 0.97 | 1.01 | — |
| Dog | 0.96 | 0.975 | 0.945 |
| Cat | 0.98 | 1.01 | 0.935 |
| Rabbit | 0.96 | 1.03 | 0.945 |
| Guinea Pig | 0.98 | 1.04 | 0.955 |

*($R_{Dial}$ is the distribution ratio for plasma and its dialysate.

of sodium and therefore, presumably, the greater osmotic pressure. This agrees with earlier findings on other species.[3] We may note, also, that the true steady-state distribution of $Na^{24}$ between plasma and cerebrospinal fluid is achieved after 24 hours, in marked contrast to the state of affairs with the intraocular fluid.

## Discussion

It seems clear that the low steady-state distribution-ratio described by Scholz was due to the failure to allow sufficient time for the equilibration of the injected isotope; as a consequence, the specific activity of the aqueous humor had not risen to its correct steady-state value. That it may require more than 24 hours for the establishment of a true steady-state is, at first thought, surprising, since studies on the kinetics of penetration of $Na^{24}$ from plasma to aqueous humor, carried out during the course of this work, gave values of the turn-over constant—$k_{out}$—varying between 0.010 and 0.009 $min.^{-1}$. From these values, one may compute that, in the absence of interfering factors, the time to reach 99 percent of equilibrium would be some eight hours. Such a calculation, however, ignores the circumstance that the isotope passes from the aqueous humor into the vitreous body (Davson, Duke-Elder, Maurice, Ross, and Woodin[4]; Maurice[5]; Davson[3]; Kinsey, Palm, and Cavanaugh[6]) as a result of these losses, the rate of equilibration becomes steadily slower so that, in the rabbit, some 24 hours are required for equilibration.

The vitreous body occupies a much greater volume, in proportion to the aqueous humor, in the monkey's than in the rabbit's eye, so that the effects of the vitreous body in delaying the achievement of the steady-state will be more pronounced in the former species. That this is the true explanation, is made most probable by the circumstance that the cerebrospinal fluid achieves the true steady-state concentration within 24 hours, in spite of the fact that the rate of turn-over of sodium in this fluid is only some half that in the aqueous humor ($k_{out}$ equal to 0.004 $min.^{-1}$).

Earlier work from this laboratory[7, 8] has shown that the distributions of the chloride and bicarbonate ions between plasma and aqueous humor show characteristic variations according to the species examined, while, as Table 2 shows, the distribution of sodium is relatively constant. One is tempted, therefore, to see in the active transport of sodium, from plasma into the posterior chamber, the fundamental step in the elaboration of the aqueous humor of all species.

An active transport of the hydroxyl-ion, leading to the accumulation of bicarbonate in the aqueous humor, as suggested by Friedenwald,[9] may well be a feature of the process of formation of the fluid in the dog, rabbit, and guinea pig, where the concentrations in the aqueous humor are considerably higher than in the plasma (Davson and Weld[10]; Cordier and Cordier[11]; Kinsey[12]; Davson and Luck[8]), but such a process cannot be considered as fundamental since, in other species, namely man,* monkey, horse, and goat, the concentration of bicarbonate is actually considerably less than in the plasma (Davson and Luck[8]). Moreover, the cerebrospinal fluid shows such strong affinities with the aqueous humor[3] that one would be

* The evidence for this assertion is both indirect and direct. As indicated above, the chloride—and bicarbonate—distributions vary with the species; it has been found, moreover, that there is an inverse correlation between the two distributions, an eye having a large excess of chloride in the aqueous humor having a relatively large deficiency of bicarbonate, and vice versa. The human aqueous humor shows a large excess of chloride (Hodgson[13]), so that, on this ground, a deficiency of bicarbonate could be safely predicted. The direct evidence is provided by analyses of plasma and aqueous humor from a human subject whose eye was about to be enucleated; the eye was completely normal, and was being removed because of an epithelioma invading the orbit. The distribution-ratio was 0.89, that is, there was a marked deficiency of the bicarbonate ion in the aqueous humor, even when allowance is made for the circumstance that the blood employed in the comparison was a venous sample.

justified in seeking similar mechanisms of formation for both fluids; in all the species examined, the sodium distributions are similar, showing an excess of this ion over that required by a Donnan distribution, and the bicarbonate distributions are likewise fairly constant, showing a *deficiency* of the ion in the cerebrospinal fluid.

The circumstance that the carbonic anhydrase inhibitor, Diamox, lowered the intraocular pressure (Becker[13]) appeared to lend support to the view of Friedenwald that an accumulation of bicarbonate was the fundamental step in the elaboration of the intraocular fluid but the fact that this drug is effective in man, and also lowers the cerebrospinal fluid-pressure in the rabbit and cat (Tschirgi, Frost, and Taylor[14]), invalidates this interpretation of its action, since the fluids concerned all have lower concentrations of bicarbonate than that in the plasma. It seems far more likely that this inhibitor interferes with the active transport of sodium, possibly in a nonspecific manner, or possibly by interfering specifically with an intermediate reaction in the complex chain of metabolic events covered by the term "active transport."

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# INTRAOCULAR ASTIGMATISM*

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Ever since the invention of the ophthalmometer (keratometer) by von Helmholtz, almost a century ago, sporadic investigations have been made as to the distribution of values of the corneal curvatures in various groups of individuals. Donders,[1] in 1864, presented a study of 117 individuals whose measurements showed a variation in the meridian of greatest intensity from a maximum of 7.11 mm. radius to a minimum of 8.39 mm. Major investigations by Bourgeois and Tscherning,[2] Steiger,[3] Leibowicz,[4] and Stromberg[5] showed essential agreement with the earlier Donders' figures, and subsequent investigations with lesser numbers of individuals have shown no significant differences in average values or distribution.

Most of the earlier work, however, was concerned with the mean value of the corneal refraction in each case and did not consider the distribution of astigmatic differences, although Donders, in his original report, presented the results of the measurement of corneal astigmatism in 20 subjects. Curiously enough, in this earlier report, six of the 20 cases were found to have corneal astigmatism *against the rule*.

Stenström[6] has summarized the previous work on the corneal refracting power, including a number of lesser investigations, and shows that the distributions fit nicely into a normal Gaussian distribution curve. He also studied in this very excellent and unique paper the correlation of axial length and refractive power, using the X-ray and other techniques, determined the approximate refracting power of the cornea using an index of 1.336, but did not investigate intraocular astigmatism or other accommodational phenomena.

With the gradual introduction of cylindric elements into spectacle lenses came an increased interest in the optical astigmatism produced by the anterior corneal surface.

In the excellent paper by Leibowicz, already referred to, will be found a very complete bibliography on this subject up until 1928. His investigations concerned not only the actual corneal curvatures, but also the variations in axis position, *with* and *against the rule* characteristics, relationship to axial ametropia, and even sex differences in corneal curvatures and corrected visual acuity. He noted that the astigmatic axes in approximately 80 percent of the cases were within 15 degrees of the horizontal or vertical; that in 85 percent the amount of corneal astigmatism was less than +2.0D.; and that the manifest *against the rule* astigmatism increases with age. Leibowicz does not, however, discuss the physiology of intraocular astigmatism or clinical methods of dealing with it. In general, his findings, where they can be correlated with the results of this study, are confirmed by it.

Javal,[7] incorporating in his book the earlier work of Burnett, endeavored to organize in a systematic way the differences which they noted between the corneal astigmatism and that of the eye as a whole, and made the first of a series of attempts to evolve a formula for the modification of the ophthalmometer results in order that they might represent more accurately the final astigmatic lens correction. This method of treatment of the data, which has ever since been known as "Javal's rule," utilized the following formula:

$$As_{(total)} = K + P \cdot As_{(corneal)}$$

Where K = .50 D. *against the rule*
P = 1.25 (a constant)
As = Astigmatism

This was soon recognized as unsatisfactory and occasional attempts have since been

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made by a number of workers to evolve a more acceptable method.

Spurred by the work of Javal, an important but little regarded paper by Martin[8] on the action of the ciliary muscle, pointed out that in a large series of cases lenticular astigmatism, mostly *against the rule*, was encountered in the majority, with the dioptric values, mostly of low amounts, not exceeding 1.25D.

In an investigation of the relationship between corneal and total astigmatism, Rowan[9] found that the total astigmatism, as determined with retinoscopy under cycloplegia, agreed with the corneal astigmatism in 48 percent of the cases. The reasons for and the nature of the disagreement among the remaining 52 percent were not presented.

The desirability of a determination of the anterior corneal astigmatism was emphasized by Elliot[10] in a paper published during World War I. Some of the reasons which he gives for urging the use of the ophthalmometer in routine refraction procedures are that it often suggests the exact axes; it will detect those cases in which the axes of greatest and least astigmatism are not at right angles; it will help in those cases of "scissors" movement, medial opacities, and other conditions where retinoscopy is difficult; it will detect slight irregular corneal astigmatism or early keratoconus; and will be extremely helpful in cases of children, restless or unco-operative patients, or those of low intelligence.

Sheard,[11] in 1920, reviewed all of the previous work, summarizing the views of Javal and Pflueger, Stadfelt, Tscherning, Nordenson, Schiøtz, and others. He again pointed out the fact that the correcting lens and the cornea do not occupy the same focal plane, and he questioned again the applicability of the Javal rule. In Sheard's opinion, there is no justification for the use of the constant "P" as more than unity. The problems of intraocular astigmatism and its relationship to corneal astigmatism, and the relation of these to the effectivity of the correcting lenses were discussed. In his paper Sheard defined clearly the various entities which are involved in the efforts to relate corneal, lenticular, and total astigmatism.

Among the more important later contributions is that of Czellitzer,[12] who studied the relationship of the total ametropia to corneal and lenticular astigmatism. He found in a large series of clinical cases that lenticular astigmatism rarely amounted to more than 1.0D.; that in about seven percent of cases it increases the corneal astigmatism; in 48 percent it equals the corneal astigmatism; and in 44 percent it decreases it. A not very successful attempt was made to relate the astigmatic condition to the presence of hyperopia or myopia.

In 1934, Sellman[13] investigated lenticular astigmatism in a number of clinical cases and found, as preceding investigators had, that it was mostly *against the rule* and varied from 0 to 2.0D., with most cases in the 0.5D. to 1.25D. range. He points out that in some of the cases there is a variation of axial position, apparently associated with accommodative activity.

Gassowsky and Samsonowa,[14] in the same year, studied the relationship of anterior corneal astigmatism to the total astigmatic error, recognizing that the differences found were due largely to the presence of intraocular astigmatism. The corneal astigmatism was found to be greater than the amount corrected by lenses prescribed in 40 percent of the cases; less in 15 percent; and approximately the same in 44 percent. Fifty-five percent of all the individuals studied had a 0.5D., or less, of lenticular astigmatism, although the other cases ranged up to 3.0D.

Hruby,[15] in a study of lenticular astigmatism and total astigmatism in some 800 eyes, found that most of them presented *with the rule* corneal astigmatism, in most cases not over 0.75D., and that lenticular astigmatism is usually within the 0.5D. to 1.0D. range, but occasionally amounts to 2.0D. Eyes with more than 2.0D. of lenticular astigmatism

were rarely encountered. In his discussion of axis position, Hruby endeavors to apply the formula for the resolution of congeneric cross cylinders with their axes at other than right angles in those cases where the axes of the corneal astigmatism did not coincide with those of the correcting lenses, but found the variations too inconstant to permit incorporation of such a process into routine refraction work.

Paycha,[16] in 1952, continued with a similar study, conluding that there is no causal relationship between the intraocular astigmatism and the corneal astigmatism, and that the astigmatic value of the final lens correction represents, in cases where the corneal astigmatism is at an oblique axis, a resolution of the corneal and lenticular components.

In none of these papers, except that of Sheard, was there any consideration of the influence of the associated spherical lenses upon the effectivity of the correcting cylinders at the anterior corneal surface. As early as 1897, however, Adolph Javal[17] recognized the importance of lens effectivity in the calculation of lenticular astigmatism, so that the idea is not new.

As a result of the investigations already cited, as well as those which are set forth in this paper, certain assumptions can be made.

First, it is evident that astigmatism, as determined by the corneal curves, will require, for precise neutralization, cylindric lenses of modified dioptric power because of the difference in optical effectivity of the lenses when they are not in contact with the cornea, but are removed one cm. to two cm. from it.

Second, and what most of the investigators mentioned have demonstrated, most eyes have some intraocular astigmatism, probably due to toric surfaces on the crystalline lens or to a tilting of that structure.

Third, it has become evident through the years that intraocular astigmatism is usually *against the rule*, may vary greatly in amount in a group of individuals, or even from time to time in the same individual, and, in a considerable number of cases, may be nonexistent.

Fourth, and finally, it must be recognized that the satisfactory correction of astigmatism is not always a purely optical problem, inasmuch as the sensory aspect must be considered, for it is entirely possible that a given individual, because of a peculiarity in his interpretational processes, will select subjectively a refraction system slightly out of focus as that which is desirable.

Another and often unrecognized difficulty may arise in astigmatic anisometropia, especially with oblique axes, in that meridional aniseikonia may interfere with binocular vision to such an extent that some modification of the axes and power of the correcting lenses may be required if the patient is to achieve comfort.

Because of these difficulties in interpreting the ophthalmometer findings, the use of that instrument has been neglected in most routine refraction procedures, despite the fact that it is the most precise for its purpose of all used in ocular examinations. However, there are many who use it for special purposes and who feel that it contributes much in certain refractive situations. Ophthalmometric determinations are essential in the study of the fundamental optical and physiologic factors underlying astigmatic measurements and as a basis for the routine clinical refraction procedures presented in this paper.

## Procedures

It seemed to be advisable, first, to study the distribution of corneal astigmatism in a large number of subjects of all ages, and to establish what might be considered a normal distribution. Then, in a statistically significant number of individuals of different ages, to determine the difference between the corneal astigmatic findings and the final lens prescription, considering the differences, if any, between various age groups and the sexes.

In the latter groups, when comparing the

corneal curvatures with the final prescription lenses, the corneal findings were first subjected to correction for effectivity of the lenses, situated at a distance of 12 mm. in front of the cornea. All cylindric corrections were expressed as concave cylinder values, permitting the spheric element of the prescription to be used for the determination of the amount to be added to or subtracted from the cylindric lens value. This was done by using Table 1, which was recalculated for the purpose.

For many years, I have measured and recorded the corneal curvatures of both patients and experimental subjects with great care, and during that time have accumulated a considerable amount of available data. All of the subjects whose measurements are embodied in this report were refracted carefully and the accuracy of the refraction verified by later observation. The case records used were selected at random from a much greater number and form a statistically significant group. All children were refracted carefully under atropine cycloplegia and all young adults with homatropine, and only those cases were used in which the relative accuracy of the lens correction was well assured.

It is possible to measure corneal asfigmatism with the ophthalmometer to an accuracy of better than 0.02 mm. of radius which can be translated into lens diopters, using the smallest ophthalmic lens unit of 0.12D., by the use of a corneal system index of refraction of 1.337. It should be noted that this index does not represent the actual index of refraction of the cornea if it were measured independently in air or with the same medium on each side of it. In that case, the index would probably be about 1.37 more or less, probably varying somewhat according to the age of the subject. In an intact eye, however, the cornea must be considered, from the refractive standpoint, as consisting of two nearly parallel surfaces with the inner surface in contact with the aqueous humor. To any single incident light ray, therefore, it acts almost as a parallel plate and the refractive effect of the anterior surface determines almost entirely its dioptric power. The opposing effect of the posterior surface is largely nullified by its contact with the aqueous humor, resulting in a relative index

TABLE 1

VALUES (IN DIOPTERS) OF CONCAVE CYLINDRIC LENSES WHICH, WHEN SITUATED AT A VERTEX DISTANCE OF 1.2 CM. AND COMBINED WITH VARIOUS CONVEX AND CONCAVE SPHERES, WILL PROVIDE AN EFFECTIVE LENS POWER AT THE CORNEA EQUAL TO THE KERATOMETER FINDINGS

| Sphere | Anterior Corneal Astigmatism | | | | | |
|---|---|---|---|---|---|---|
| | 1.00 | 2.00 | 3.00 | 4.00 | 5.00 | 6.00 |
| | Rx cylinder (concave) | | | | | |
| +8.00 | 0.75 | 1.62 | 2.50 | 3.25 | 4.25 | 5.37 |
| +6.00 | 0.87 | 1.62 | 2.62 | 3.50 | 4.67 | 5.67 |
| +5.00 | 0.87 | 1.75 | 2.62 | 3.62 | 4.75 | 5.75 |
| +4.00 | 0.87 | 1.87 | 2.75 | 3.87 | 4.87 | 5.87 |
| +3.00 | 0.87 | 1.87 | 2.67 | 3.87 | 4.87 | 6.00 |
| +2.00 | 1.00 | 2.00 | 3.00 | 4.00 | 5.00 | 6.12 |
| +1.00 | 1.00 | 2.00 | 3.00 | 4.12 | 5.12 | 6.25 |
| 0.00 | 1.00 | 2.00 | 3.12 | 4.12 | 5.25 | 6.50 |
| −1.00 | 1.00 | 2.12 | 3.25 | 4.25 | 5.25 | 6.62 |
| −2.00 | 1.12 | 2.25 | 3.37 | 4.37 | 5.37 | 6.62 |
| −3.00 | 1.12 | 2.25 | 3.37 | 4.50 | 5.62 | 6.87 |
| −4.00 | 1.12 | 2.37 | 3.50 | 4.62 | 5.75 | 7.00 |
| −5.00 | 1.25 | 2.37 | 3.50 | 4.75 | 5.87 | 7.25 |
| −6.00 | 1.25 | 2.37 | 3.50 | 4.75 | 6.00 | 7.37 |
| −8.00 | 1.62 | 2.37 | 3.75 | 5.00 | 6.25 | 7.50 |
| −10.00 | 2.12 | 2.62 | 3.87 | 5.12 | 6.37 | 8.00 |

of approximately 1.03 and an almost negligible refractive effect.

The acceptable index for our purpose, therefore, is that of the whole corneal system, consisting of cornea, aqueous humor, and vitreous body, and approximating, as noted above, 1.337. If this index is accepted, the refractive power can be determined from the simple formula $F = n - 1/r$ and it is this value which is used in most ophthalmometers. The possibility of error in this translation of curvature into dioptric equivalents is further reduced by the fact that the differences in dioptric values caused by slightly incorrect indices within the possible range of inaccuracy would be negligible, in fact, at their greatest, far below the usual 0.12D. minimum lens difference. We can safely assume, therefore, that the ophthalmometer findings, in diopters, represent a very close approximation of the actual values.

Littman[18] and others have raised some question regarding the validity of the ophthalmometer findings because of the relatively wide separation of the mire images on the cornea. If the instrument is used in the usual fashion, the images of the mires will be separated on the cornea at a distance about equal to the average pupillary diameter. With this possible error in mind, many of the subjects used in the present study were subjected to a second reading made with the mires close together, so that the right and left images were reversed and the corneal reflections confined to the central pupillary area. This procedure was later discontinued, however, after it had been found that there was no appreciable difference in the results when compared with those obtained by the normal procedure.

When the scale reading recorded a finding about half way between 0.12D. and 0.25D., the amount usually was expressed as the nearest 0.25D. This practice was reflected in Figure 1, which shows the predilection for the 0.25D. readings. However, from a practical standpoint, the findings can be expressed acceptably in 0.25D. steps, and that is done in the succeeding distribution curves.

Sex differences are not reflected in the data presented, as no significant variation in either direction was found in comparing the corneal astigmatism value of males with those of females. This observation agrees with the findings of Leibowicz, who made a detailed study of this matter in the paper quoted above.

In the random selection of cases to be used in this study, occasional instances of irregular corneal astigmatism were encountered. These were classified as to type, provided no actual structural lesions had been found with a careful slitlamp examination. There were 68 of these eyes found during the random selection process, which was continued until a total of 2,000 eyes with regular astigmatism was reached.

## Results

The results of the measurement of the 2,000 eyes with regular astigmatism by the ophthalmometer are plotted in Figure 1. In cases where the actual finding fell between 0.12D. and 0.25D., the value was noted in the 0.25D. column, thus showing an apparent predilection for the 0.25D. values and producing a somewhat spiked graph. In Figures 3 to 6, this disparity is ironed out by combining the 0.25D. values with their next higher 0.12D. The amounts in this series vary from those in which no astigmatism is manifested to a high of 5.87D., and the actual dioptric values of the corneal surface varied from 36.25D. to 48.0D.

Figure 2 shows the distribution of corneal radii and dioptric power of the primary meridans, secondary meridians, and the mean values in these 2,000 eyes, with the amount in diopters calculated to the nearest 0.25D. of anterior corneal astigatism. In the same 2,000 eyes, 1,575 presented corneal astigmatism ranging between 0.25D. and 1.5D. Only 12 of the number had perfectly

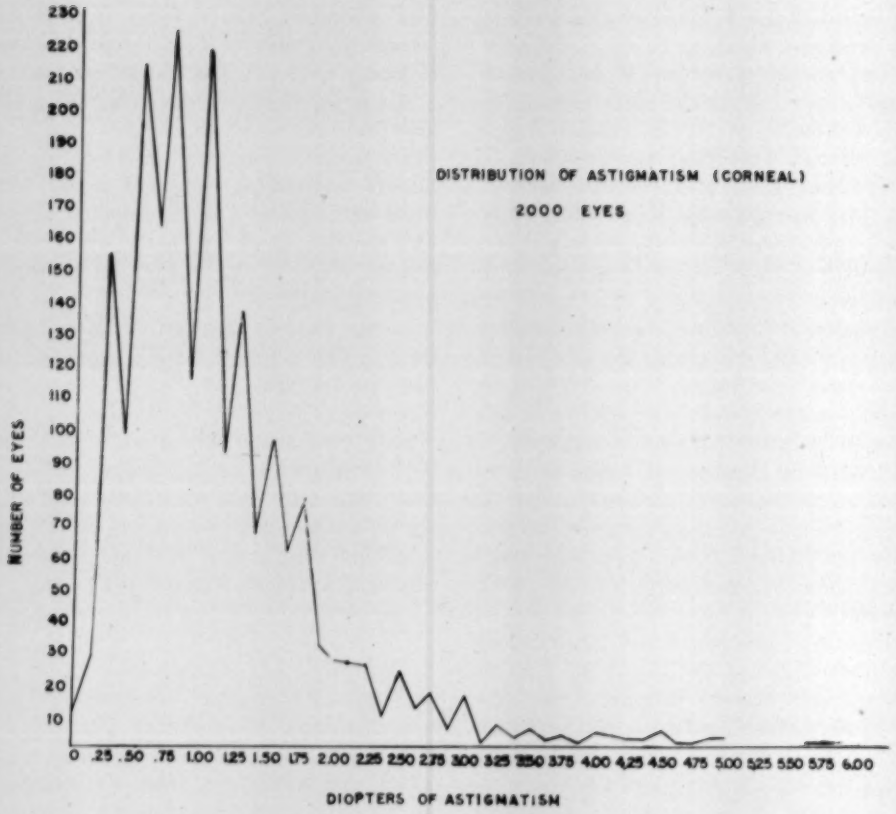


Fig. 1 (Tait). Distribution of corneal astigmatism in diopters in 2,000 eyes.

spheric corneas, while 29 more were practically spherical with an astigmatic value of 0.12D. or less. Only 30 of the 2,000 eyes presented more than 4.0D., and only two more than 5.0D. Very occasional instances of regular corneal astigmatism of more than 6.0D. have been encountered in my private practice, but none occurred in the individuals included in this series.

In my experience, there had been some variations in the data obtained at different ages, so, for purposes of study, four arbitrary groups were selected: five to 10 years, 15 to 25 years, 30 to 45 years, and 50 to 65 years. In each of these groups 400 eyes are reported, noting the age and sex of the subject, the ophthalmometer values, including the amount of the astigmatism in diopters, the major axes, whether the astigmatism was *with* or *against the rule (with the rule* cases are those in which the greatest curvature is in the vertical meridian or within 45 degrees of either side of it, and *against the rule* those with the lesser curvature in the same quadrant), and the dioptric value of the lesser meridian.

In each case, the final verified lens correction was recorded with the cylindric element, if any, expressed as a concave cylinder.

By the use of the spherical element accompanying the cylindric value, the keratometer finding was modified, if necessary, by re-

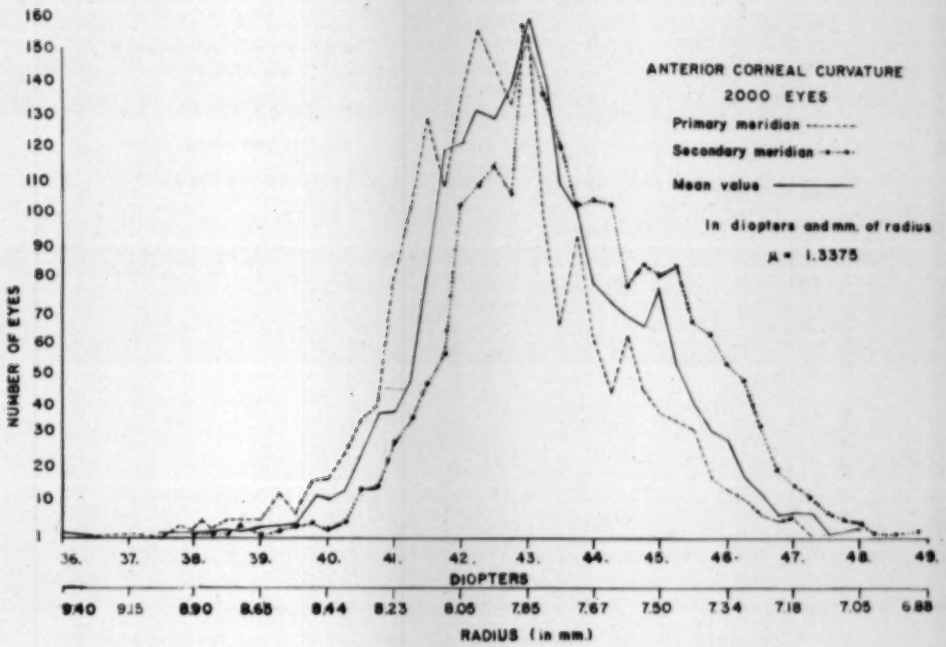


Fig. 2 (Tait). Distribution of corneal radii and dioptric power of the primary and secondary meridians and their mean values in 2,000 astigmatic eyes.

ferring to Table 1 in order to find the cylinder value which, when incorporated into an ophthalmic lens situated at 12 mm. in front of the cornea, would give the same astigmatic effect at the corneal surface as actually exists. This cylindric modification, in turn, was compared with the actual corneal curvature expressed in diopters, and the difference, both numerical and whether *with* or *against the rule*, noted.

Figures 3, 4, 5, and 6 presents the distribution of intraocular astigmatism in the five- to 10-year, 15- to 25-year, 30- to 45-year and 50- to 65-year groups, respectively. It will be noted that there is a small but constant progression in the incidence of the *against the rule* intraocular astigmatism with age. The great majority of the five- to 10-year group is included in the 0.25D. to 0.5D. range; the 15- to 25-year group and the 30- to 45-year group have their greatest values between 0.25D. to 0.75D., while the 50- to 65-year group includes a considerable number of eyes presenting 1.0D. or more of this type of astigmatism.

In the five- to 10-year group, there were very few who presented intraocular astigmatism of more than 1.0D. In the 15- to 25-year group, however, almost one fifth were higher than 1.0D., and this ratio was maintained in the other two older groups.

*With the rule* intraocular astigmatism is comparatively rare in the five- to 10-year group, presenting only nine eyes out of 400. Nineteen eyes, exhibiting this condition, were encountered in the 15- to 25-year group; 15 in the 30- to 45-year group; and 19 in the 50- to 65-year group. Thus, there is little significant difference in the adult groups as far as this type of astigmatism is concerned, but the children exhibit it rarely, and it may be noted that when it was present

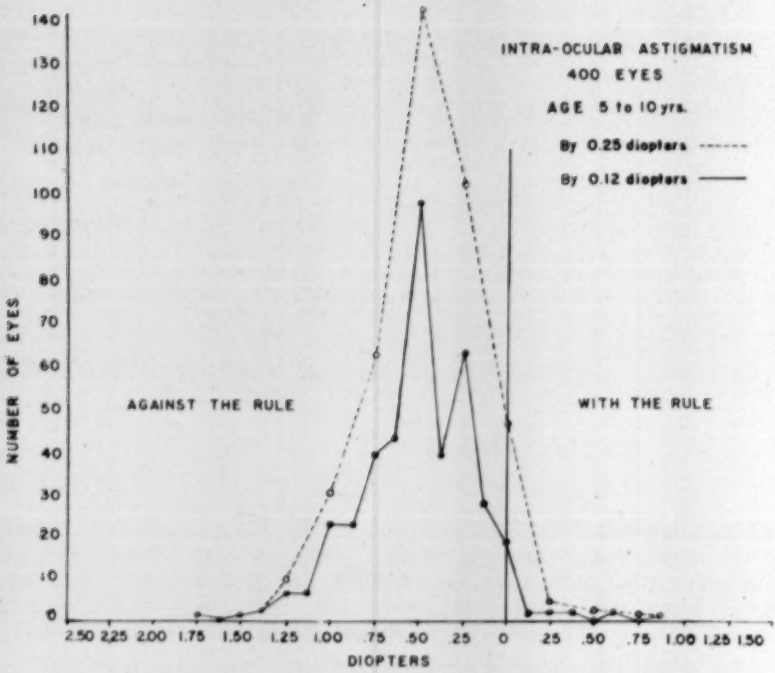
INTRA-OCULAR ASTIGMATISM
400 EYES
AGE 5 to 10 yrs.
By 0.25 diopters
By 0.12 diopters
NUMBER OF EYES
AGAINST THE RULE
WITH THE RULE
DIOPTERS
2.50 2.25 2.00 1.75 1.50 1.25 1.00 .75 .50 .25 0 .25 .50 .75 1.00 1.25 1.50

Fig. 3 (Tait). Distribution of intraocular astigmatism in diopters in 400 eyes. Subjects five to 10 years of age.

in their group, the amount was usually about 0.25D.

During the study, a number of interesting points emerged. For example, it was somewhat surprising to find that the distributions of the positions of the major axes of corneal astigmatism varied very little in the three younger age groups, but suggested a change toward the inclined position in the oldest group. Table 2 shows the position of the major axes of the corneal astigmatism in each group. This is of little significance from the clinical standpoint, except to indicate that anything may be expected in a given case.

Also among the findings of interest was that of the prevalent inequality in the amounts of intraocular astigmatism in a pair of eyes. In fact, a great majority of the cases had some slight but definite difference.

An occasional finding was that of *against the rule* total astigmatism when the anterior corneal astigmatism was *with the rule*. This, of course, was to be expected in view of the almost universal occurrence of *against the rule* intraocular astigmatism. In several instances, however, small amounts of *with the rule* intraocular astigmatism were observed with both *with* or *against the rule* total astigmatism.

TABLE 2

POSITION OF MAJOR AXES OF REGULAR CORNEAL ASTIGMATISM—400 EYES IN EACH OF FOUR AGE GROUPS

| | Number of Eyes | | | |
|---|---|---|---|---|
| Position of Axes | 5–10 yr. | 15–25 yr. | 30–45 yr. | 50–65 yr. |
| 90–180 degrees | 230 | 227 | 219 | 179 |
| Inclined | 156 | 164 | 159 | 183 |
| No astigmatism | 14 | 9 | 22 | 38 |

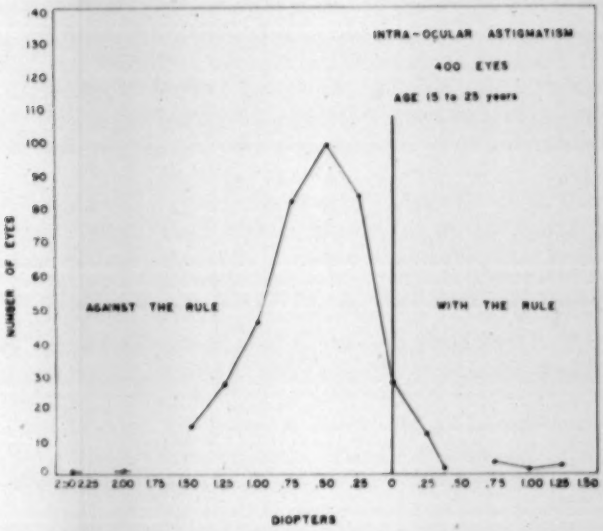


Fig. 4 (Tait). Distribution of intraocular astigmatism in diopters in 400 eyes. Subjects 15 to 20 years of age.

Irregular astigmatism, as found in 68 of 2,068 eyes, and shown in Table 3, was an important by-product of the use of the ophthalmometer. In these cases, a careful slit-lamp examination failed to reveal any lesions in the cornea and yet there was corneal irregularity sufficient to interfere with vision in each case. In 12 of these 68 eyes was presented the characteristic ophthalmometer mire distortion of early keratoconus and 56 exhibited more or less irregularity of the anterior corneal surface. Without the use of the ophthalmometer, the reason for the lowered visual acuity could only have been guessed at.

For many years, I have been using the ophthalmometer routinely in all cases, but with exceeding care and patience in the case of young children. It is possible to obtain reliable ophthalmometer readings in intelli-

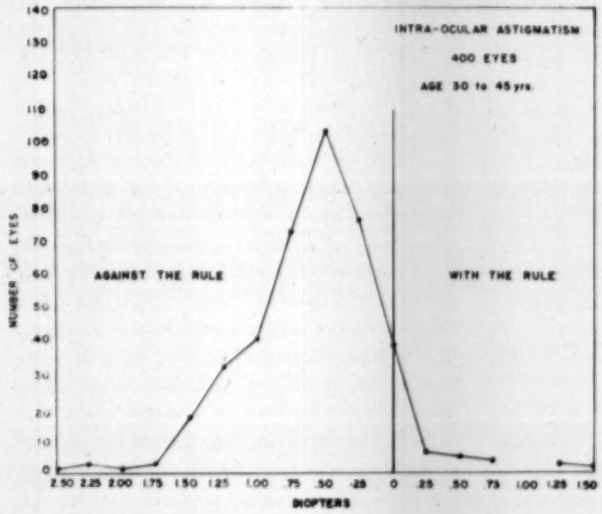


Fig. 5 (Tait). Distribution of intraocular astigmatism in diopters in 400 eyes. Subjects 30 to 45 years of age.

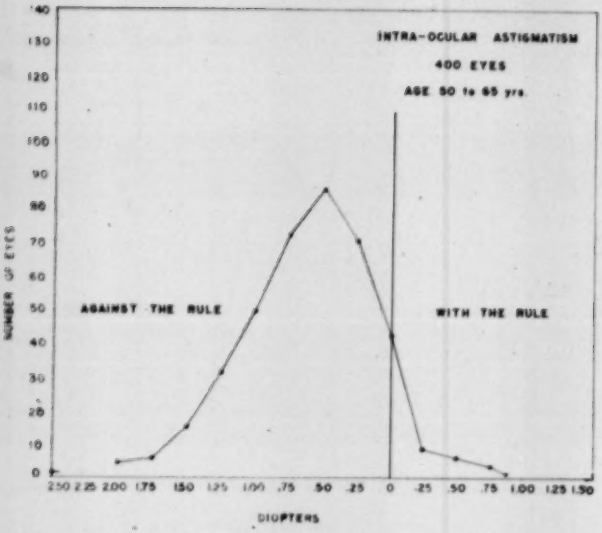
INTRA-OCULAR ASTIGMATISM
400 EYES
AGE 50 to 65 yrs.
AGAINST THE RULE
WITH THE RULE
NUMBER OF EYES
DIOPTERS
2.50 2.25 2.00 1.75 1.50 1.25 1.00 .75 .50 .25 0 .25 .50 .75 1.00 1.25 1.50

Fig. 6 (Tait). Distribution of intraocular astigmatism in diopters in 400 eyes. Subjects 50 to 65 years of age.

gent and co-operative children of two years of age and over, and very often the findings will immediately demonstrate the reason, in the form of high astigmatic error or other corneal irregularity, for a visual difficulty.

While not included in this series, I have had considerable experience with the value of ophthalmometer findings in cases presenting a ciliary muscle hypertonus with transitory lenticular astigmatism. These individuals often present objective and subjective findings with manifest and cyclopegic procedures in which the apparent astigmatism is so very different from that found by the ophthalmometer as to be far outside of the normal range of intraocular astigmatism, as shown in the distributions in Figures 3, 4, 5, and 6. In these cases, later changes in manifest astigmatic tests demonstrate that there was present an exaggerated lenticular astigmatism not readily relieved by cycloplegia, a condition which, in my experience, is often the cause of considerable asthenopia. The ophthalmometer permits a differential diagnosis in this condition, with a resulting suggestion as to the proper procedure for correction.

TABLE 3

TYPE OF ANTERIOR CORNEAL ASTIGMATISM IN 2,068 EYES

| | | |
|---|---|---|
| Irregular astigmatism | | 68 |
| Keratoconus | 12 | |
| Anterior irregularity | 56 | |
| Regular astigmatism | | 2,000 |
| With rule | 1,878 | |
| Against rule | 122 | |

For ordinary clinical purposes, if the ophthalmometer values are to be used intelligently in the analysis of the results of a refraction procedure, it is necessary to devise a satisfactory method of interpretation and application.

## CLINICAL APPLICATIONS

From the foregoing, it can be seen that the data obtained by the use of an ophthalmometer during a routine refraction procedure may often be very helpful in the diagnosis and correction of obscure problems in ocular refraction. It is true that only about 15 percent of all refraction cases offer any real problems, but the short time required for ophthalmometer determinations during the examination routine and the great value of the findings in this minority of cases justify, in my opinion, the use of the instrument in all refractive cases.

The actual information obtained by the procedure may be summarized as follows:

1. Actual radii of curvature of the anterior corneal surface and their approximate dioptric refraction equivalents.

2. Regularity or irregularity of the toric or spheric anterior corneal surface.

From the first of these can be determined, by subtracting the lesser dioptric value from the greater, the approximate amount of anterior corneal astigmatism. This, in turn, would have to be modified if any great amount of hyperopia or myopia is present and if it is to be correlated to a lens situated some distance in front of the eyes. The use of Table 1 permits this to be done without calculating each case individually. The values thus obtained may then be compared with the results of the other refraction procedures, all of which include the total astigmatic component of the refractive error, so that the intraocular astigmatism may be determined. When interpreted in terms of the intraocular astigmatism frequency curves, as presented above, it is then possible to postulate whether or not the lenticular astigmatic component is permanent or if it is merely part of a ciliary muscle hypertonus which will disappear when the hypertonus is relieved. Elsewhere, I[19] have described this process in detail.

In the majority of refraction cases, the use of the retinoscope and the subjective method suffice to provide the patient with an acceptable lens correction. However, the added assurance of accuracy in prescribing lenses which is provided by those cases in which the ophthalmometer corroborates the findings by other methods is well worth, in my judgment, the slight extra effort expended in using the instrument.

The greatest value of ophthalmometry, however, is undoubtedly in the case of those persons who present anterior corneal astigmatic values which do not at all agree with the total astigmatism found by other methods. A real discrepancy between these two is a danger signal, suggesting a compensatory process which may be related to a ciliary muscle hypertonus and so subject to considerable variation without warning. Oftimes, even the use of homatropine, cyclogyl, or similar cycloplegics will not relieve such a condition immediately, although most will relax over a period of time with continued treatment or with the relief of the ciliary muscle effort usually responsible. Such cases may therefore be expected to require a change in correction lenses in the near future and the patient may be so informed and directed to return within a few weeks or months for further examination.

While this type of accommodative abnormality is most likely to be in the age groups in which a ciliary muscle hypertonus usually develops, that is the third decade of life and the immediate presbyopic period, it may develop at any time prior to the age of 50 years.

In many of these cases which present a discrepancy, the intraocular astigmatism may be fixed and permanent, but nothing is lost by expecting difficulties, even if none appear, and certainly it is much to the interest of the patient to be sure in the matter.

The value of the ophthalmometer in the refraction of children, of illiterates, and of the nonco-operative individual is self-evident. In the case of children, as shown by the above frequency graphs, intraocular astigmatism is infrequent and the instrumental results are usually immediately applicable after the necessary effectivity calculations have been made. The value of the procedure in the refraction of children is, in my opinion, incontestable.

Aphakia is another condition in which the ophthalmometer data are of especial value. Because of the absence of the crystalline lens, the eye becomes, for all practical purposes, a single refracting surface and the corneal astigmatism approximates, with due allowance for lens effectivity, the actual correcting cylindrical component of the correcting lens. Time and effort can be saved by the use of the instrument during the refraction procedure.

Occasionally, a cataract operation produces some temporary or permanent irregular corneal astigmatism which makes good vision difficult with the best lens correction. The ophthalmometer will immediately reveal the irregularity and thus the reasons for the visual difficulty.

Another but little appreciated value of the ophthalmometer determinations is that they permit a differentiation in anisometropia cases between those which are caused by different anteroposterior lengths of the two eyes and those in which the refractive inequality is due to different corneal curvatures. This differentiation is quite important when considering the possibility of aniseikonia as a cause of continued difficulties with sensory fusion and binocular vision.

Careful refractionists encounter occasional cases in which normal or near normal vision cannot be obtained, even though there is no apparent structural abnormality in the media or fundus. While some of these may be due to lesions in the postbulbar afferent visual nervous system, many are due to anterior corneal irregularities, including early keratoconus, which cannot be recognized or definitely diagnosed with the ophthalmoscope, retinoscope, or with the slitlamp. In such cases, the ophthalmometer immediately demonstrates the reason for the visual deficiency.

## Summary

Ophthalmometer determinations are of outstanding value in many ocular refraction cases, but it is impossible to select in advance those of the whole group in which they will be of major importance, so that, in my opinion, the instrument should be used in every case, especially in view of the little time required. Indeed the instrument may be used by the refractionist's office assistant if he does not desire to use it personally, and the test can be completed within one minute after a patient has been placed in the proper position. Difficulties in the application of the test results, which formerly discouraged the use of the instrument, can be largely overcome by an understanding and an application of the principles and methods developed in this paper.

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# ESOTROPIA AND CONVERGENT FIXATION DISPARITY*

## Of small degree: Differential diagnosis and management

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*San Francisco, California*

The differential diagnosis of patients with a small degree of esotropia and those with a small degree of convergent fixation disparity is frequently confusing. It is important to recognize the characteristics because the prognosis and management of each case may be entirely different. Knowledge of the differences aids in understanding the pathologic physiology of strabismus.

Much of the difficulty arises from conflicting definitions, as well as from the lack of secure clinical criteria and tests by which to differentiate some cases of convergent fixation disparity from small degree esotropia, when one seemingly merges into the other.

It is the purpose of this paper to define and describe these two entities and to discuss their clinical differences with regard to diagnosis, prognosis, and management.

### Definitions

#### Fixation disparity

Fixation disparity is also known in the literature as retinal slip,[1] cortical slip,[2] and flicker cases.[3] It may be defined as the amount by which the visual axes miss exact intersection at the point of regard during conditions of single binocular vision. Fixation disparity, therefore, is a heterophoria in which there is not exact bifoveal fixation. Single binocular vision is a more general descriptive term of a fusion status but does not imply the presence or absence of the more critical single bifoveal fusion.

#### Heterophoria

Heterophoria may be defined as a deviation of the eyes kept latent (compensated) by fusion.[4] It is a manifest deviation of the eyes, under usual conditions, in the absence of fusion (not compensated). Fixation disparity is an intermediate state, and, like heterophoria and heterotropia, is also an ocular deviation, belonging primarily to the class of heterophoria because of its sensory characteristics, yet exhibiting some of the characteristics of heterotropia because of its sometimes partially or wholly manifest deviation of small degree.

This simplified definition of heterphoria may be modified to include three types of ocular deviations. The deviation may be (a) wholly latent, totally compensated; (b) partially compensated by the fusion mechanism, leaving a remaining partially manifest deviation; (c) totally noncompensated, exhibiting a wholly manifest deviation (yet

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belonging to the class of heterophoria by all its sensory characteristics).*

A definition may lose its practical usefulness in fringe or transitional instances. Difficulty arises in the present problem by adhering too rigidly to that which is manifest (tropia) and that which is latent (phoria), because whether an ocular deviation is manifest or not becomes dependent upon that which is observable (objective) or measurable (subjective).

### Objective tests

Objective tests, such as the cover tests, depend upon the acuteness of the observer. Some sharp-eyed observers can detect two prism diopters of ocular movement, while other less acute observers may not detect an ocular movement of less than four to five prism diopters. With a loupe or other optical device, one could probably increase the sensitivity of observation to one prism diopter, or indeed less, if a corneal mirror device were used. Ludvigh[6] has found that under normal conditions one to two prism diopters of horizontal movement may be detected by clinical cover test, with greater sensitivity when magnification is used by the observer. It becomes obvious that an objective observation of the cover test ocular movement is not an infallible or finite criterion by which to differentiate heterophoria from heterotropia.

### Magnitude of deviation

Magnitude of deviation alone is likewise not a valid criterion by which to differentiate these conditions, even assuming infinite accuracy of measurement. Lancaster[7] clearly states this as follows:

"Phorias and tropias are both deviations. In both, the visual lines do not meet at the point of fixation. The difference is not in the magnitude of the deviation. One can have a phoria with a deviation of 20 or 30 prism diopters, and one can have a tropia with a deviation of only 2 or 3 prism diopters."

Similarly, convergent fixation disparity cannot always be differentiated from small degree estropia by the relative magnitude of cover test ocular movement. For example, a three to four prism diopter constantly convergent eye may be observed to abduct in order to fixate a distant target when a cover is placed before the fixing eye. This merely indicates an absence of bifoveal fixation but does not at all indicate whether it is a convergent fixation disparity (a type of heterophoria) or a small degree esotropia. It is not possible to set an arbitary dividing line between the two conditions upon a basis of magnitude of deviation since a well-defined small degree esotropia may be larger or smaller than a like amount of convergent fixation disparity.

There is one type of convergent fixation disparity, however, that may be diagnosed by the cover-uncover test alone. In this instance the slightly convergent constantly deviating nonfixing eye adducts further when covered and when uncovered abducts to return to its usual slightly convergent position. This eye abducts still further to fixate the target when the normally fixating eye is now covered (fig. 1). In this special instance the fixation disparity usually must be at least two prism diopters in order to observe it, with a total esophoria of at least four to five prism di-

* "Thesis and antithesis do not necessarily exclude one another. When we pass in review the antitheses which confront the biologist, we see that, in general, they cannot be called examples of strict alternatives of the 'either-or-' type. They belong to the 'both-and-' category, for they tend, as we have shown, to be pairs of partial truths which seem opposed because of their incompleteness, but are capable of being brought together in a statement of higher order, approaching a degree nearer to the full truth than either of them does singly." Further, in discussing Hegel's coincidence of contraries—"The fact that it is possible for A to be both A and not A. . . . It is clear that, if such a point of view be accepted, the pursuit of truth becomes an infinitely more complex matter than if we were content with the naive notion that A is either A or not A. The coincidence of contraries undermines the simple 'either-or' solution of any knotty problem, because no continuous linear sequence of thought can do justice to truth, if its multifaceted character is appreciated fully.[5]."

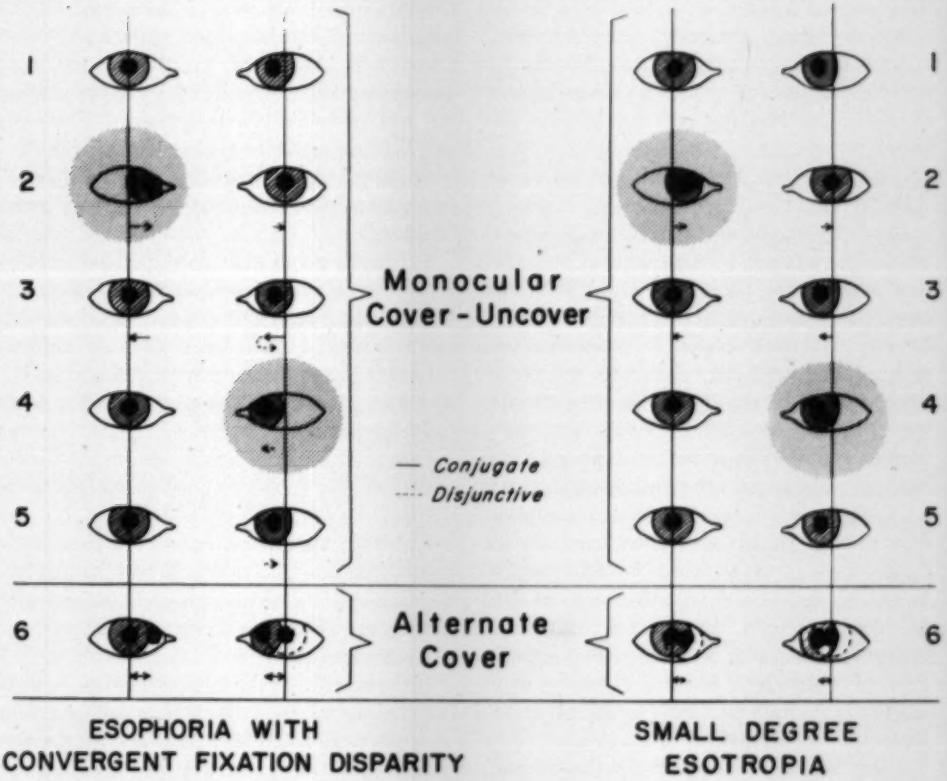


Fig. 1 (Jampolsky). Diagram showing ocular movements of esophoria with convergent fixation disparity as compared with small degree esotropia in the monocular cover-uncover test and the alternate cover test. (Stippled circle represents cover paddle.) In this special example, a left eso deviation exists in either case. Covering the right eye results in abduction of left eye to fixate. Removal of cover from right eye results in refixation of normally fixing right eye and return of left eye to slightly adducted position (1-3). A cover placed before the slightly convergent left eye results in no movement of that eye in the case of small degree esotropia. But in convergent fixation disparity, the covered slightly convergent, constantly deviating nonfixing eye adducts further (4), and when uncovered (5), abducts to return to its usual slightly convergent position. The alternate cover test (6) results in uncovering alternate eso deviation in either case, of an amount equal to the abduction of the left eye in (2) for esotropia, and of a greater amount than noted in the abduction of the left eye (2) in fixation disparity. Such cases of convergent fixation disparity, which may be differentiated by cover test, are of infrequent occurrence.

opters. In this special circumstance the fixation disparity is an observable partially manifest deviation with a partially latent residual of the total esophoria, and may be diagnosed by objective cover-uncover test criteria because both the latent and manifest portions of the ocular deviation are grossly observable. If the fixation disparity approximates or equals the magnitude of heterophoria, then the latent residual portion is too small to be directly observed and one cannot establish the diagnosis of fixation disparity by cover test alone. Similarly if the fixation disparity (manifest portion of the heterophoria) is less than two prism diopters one cannot accurately detect it by cover-uncover test alone.

Whenever cover test observations are not precise enough for small amounts of heterophoria, fixation disparity, or heterotropia,

then increased accuracy of tests may be obtained by good subjective measurements. This is a frequent clinical procedure in the routine diagnosis of small amounts of phoria by red glass, Maddox rod, and similar devices.

### Subjective tests

Subjective tests are a most accurate and acceptable method of determining the relative position of the visual axes, with the important qualification, however, that one is certain that the patient's subjective responses are capable of relating the true relative positions of the foveas. In other words, one must be absolutely certain that only normal retinal correspondence exists if one is to rely upon subjective responses. Examiners sometimes make the false assumption that normal retinal correspondence always exists, with consequent confusing interpretation of the results of the red glass and Maddox rod tests. In patients with small degree of esotropia, or those with small degree of convergent fixation disparity, it is not always certain or simple to determine the status of the retinal correspondence.

Patients with convergent fixation disparity, being heterophorias, always reveal normal retinal correspondence. Patients with small degree esotropia, being true heterotropias, may therefore have either normal or anomalous retinal correspondence. Thus, from a clinical standpoint it may be said that if anomalous retinal correspondence may be demonstrated by accurate tests, then it may be assumed that the small convergent deviation under question is probably a small degree esotropia. If normal retinal correspondence is demonstrated, it may be either esotropia or fixation disparity. The determination of anomalous correspondence is indeed difficult by the clinical haploscopic techniques in the small degree convergent deviations. The haploscopic targets must utilize the more accurate vernier alignment power rather than the usual picture target which, even though small in size, may lead to erroneous interpretation and has caused much confusion. This has been described elsewhere.[8] It should be mentioned that the demonstration of "fusion" for the perimacular and peripheral retinal areas, when observing fusionable targets in haploscopic devices, does not differentiate fixation disparity from esotropia since either may report such "fusion."

It is to be noted, therefore, that subjective sensory tests do not necessarily differentiate the two conditions when one merges into the other, except in the instance when anomalous retinal correspondence may be demonstrated, in which case a small degree esotropia may be assumed to be present.

### Physiologic basis of convergent fixation disparity

A better understanding of the phenomenon of fixation disparity will be obtained by appreciating the relationship of physiologic nystagmus, Panum's area, retinal rivalry, and suppression.

Because of physiologic nystagmus, exact and steady bifoveal fixation is not possible in a physical sense. The eyes are constantly in motion when apparently steadily fixating an object of regard. Within certain limits (foveal Panum's areas) the visual axes miss exact bifoveal fixation under normal conditions. Thus, everyone has a minute amount of "normal fixation disparity."

Correspondence *points* such as the foveas, therefore, in a physiologic sense, are actually small *areas* of correspondence. These are not fixed and finite in extent, but have a certain plasticity, depending upon the method of measurement and training factors in the observer.

The point at which the amount of physiologic error in bifoveal fixation exceeds the limit for *single* bifoveal vision, defines the limits of what are known as foveal Panum's areas. Similar Panum's areas exist (as a cortical concept) around all other corresponding retinal points.

Corresponding Panum's areas may be de-

fined, in one manner, as areas of correspondence (cortical) within which there is *single* binocular vision. For the foveal areas these are estimated to have an angular measurement of approximately six minutes.[9]

Panum's areas have been demonstrated to be elliptic horizontally and show a rapid increase in size away from the maculas toward the peripheries of the retinas. Although diagrammatically portrayed retinally, they are in actuality cortical, and are "anatomically indeterminate and physiologically labile projections."[10]

The problem of fixation disparity is primarily concerned with the foveal areas of Panum. In normal patients diplopia will result if the nondominant visual axis misses bifoveal fixation by an amount greater than Panum's area at the fovea. For an individual with a large foveal Panum's area, there would be more allowable fixation disparity before diplopia occurs. If an area of foveal or macular suppression exists, this acts "as if" Panum's area has been enlarged, extending the area of single binocular vision, allowing more fixation disparity to take place before diplopia is elicited. The loss of normal foveal retinal rivalry may follow, leading to suppression which easily follows a difference existing in the clarity of the two foveal images. A difference in sharpness of contours between each retinal image may result in more attention to the better one, with persistent dominance, loss of rivalry, and resultant suppression. The demarcation line is ill defined between a normal or physiologically large foveal Panum's area, and what may be considered a pathologic foveal suppression. Though the two differ in physiologic basis, relative to fixation disparity, they act "as if"* foveal Panum's areas are stretched and enlarged. If foveal or macular suppression exists, the amount of fixation disparity allowable is determined by the extent or border of the region of suppression. Further manifestation of any partially latent ocular deviation is prevented or "locked"[11] by fusion within Panum's areas adjacent to the suppression area.

In summary, it may be stated that fixation disparity is limited by the size of Panum's area at the edge of the most central (foveal or axial) fusionable border. This border may be the limit of the suppression area, or artificially introduced by the measuring technique. This concept may be clarified by Figure 2. A normal patient observes the similar haploscopic targets before each eye (a) under conditions of gradually induced or forced convergence. Diplopia is first noted for the central foveal dot (b) and (c) long before the perimacular ring (d) and (e) is seen diplopically, and finally diplopia occurs for the peripheral ring (f). If a target with only the large peripheral ring is used, without any of the more central fusionable detail, it is obvious from the above that a large

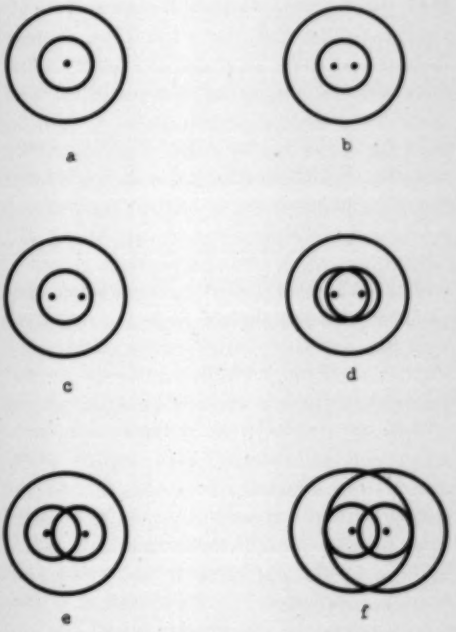


Fig. 2 (Jampolsky). Diagram showing relationship of fixation disparity to central and peripheral fusionable contours.

* Vaihinger's *Philosophy of the As If* as quoted by Curtis and Greenslet from Havelock Ellis' *Dance of Life*.[12]

amount of fixation disparity may occur in this special circumstance before diplopia becomes evident for the particular sized ring chosen. The latter experiment in no way measures the amount of fixation disparity occurring in nature under conditions of casual everyday seeing, although such artificial laboratory procedures have been described as so doing.

### Convergent fixation disparity as it occurs in the state of nature

In order to determine the amount of fixation disparity occurring under conditions of everyday seeing, the test situation must allow for the possibility of bifoveal fixation to occur, since it is the error in this situation that one wishes to measure. If the test situation makes it artificially possible for the patient to miss bifoveal fixation, through the absence of central fusionable detail, a greater amount of fixation disparity may be determined than occurs in nature. Therefore, haploscopic targets designed subjectively to determine the amount of fixation disparity existing in a state of nature must allow the possibility of bifoveal fusion to occur by including similar fusionable detail over the whole of the visual field, especially foveally. Such targets may be termed parafoveal (including the fovea) in contrasts to perifoveal (around but not including the fovea).[13]

The relationship between fixation disparity and heterophoria is well recognized and has been extensively investigated by Ogle.[14] Patients with heterophoria do not experience diplopia as long as the deviation is held sufficiently latent by the fusion mechanism and the visual axes are "locked" within an area determined by the size of the foveal Panum's area or area of foveal suppression. It is "as if" all patients with heterophoria would like to allow the visual axes to slip (cortically) in the direction of the heterophoria, if conditions permitted. An area of foveal suppression would allow this to occur, as would an artificially introduced central foveal blanked-out area in a haploscopic target.

It is to be emphasized, therefore, that such perifoveal targets, as well as haploscopic devices which may induce instrument convergence, are highly artificial circumstances and do not necessarily measure the amount of fixation disparity as it exists in the state of nature. Adequate targets must include foveal as well as peripheral fusionable detail, the determination of the amount of fixation disparity being measured by nonfusionable dissimilar details (such as vernier lines) any place in the visual field.*

### Clinical diagnosis of convergent fixation disparity and small angle esotropia

The exact measurement of the amount of fixation disparity is a laboratory procedure. From the clinical point of view one is not interested so much in the degree of anomalies, but in the more fundamental question of whether or not the patient with a small eso deviation, exhibiting a small monocular movement to clinical cover-uncover test, has a convergent fixation disparity or a small esotropia. From the discussion already given, it is to be emphasized that objective cover-uncover tests differentiate the two conditions only in the one clear-cut example cited (fig. 1). Similarly, subjective measurements do not always clearly establish the

* Attention is called to the fact that the remarks in this paper apply only to convergent fixation disparity and esotropia. In exophoria it is probable that the amount of physiologic foveal suppression, or foveal Panum's area size, remains relatively constant within physiologic limits regardless of the magnitude of exophoria. Recent experiments[16] have indicated that a variable amount of fixation disparity may occur in esophoria but not in exophoria. It is postulated that this mechanism is associated with the varying amounts of foveal suppression that may exist in esophoria as compared to the relatively fixed amount of foveal suppression in true exophoria. It is also of interest in this regard to note the relative infrequent occurrence of patients with constant exotropia of less than five to 10 prism diopters, which is in marked contrast to the number of existing cases of small constant esotropic deviations.

presence or absence of a small amount of anomalous correspondence and are therefore likewise not infallible in aiding the clinical differentiation of these two conditions.

From a practical viewpoint the following empirical correlations have been found to be clinically useful. Patients with a small residual convergent deviation following the optical correction of a significantly high hypermetropia usually are found to have a convergent fixation disparity. On the other hand, patients with a postoperative residual small degree convergent deviation usually are found to have a small angle esotropia.

### Clinical significance and management

Fortunately, relative to treatment, it is of little clinical importance to differentiate these two conditions. Patients with small degree esotropia are cosmetically satisfactory, asymptomatic, require no treatment and are usually orthoptic and surgical failures. Patients with small degree convergent fixation disparity are cosmetically satisfactory, are only rarely symptomatic (in the same regard as other symptomatic esophoric patients), and therefore only infrequently need treatment.

In my opinion, management of these two conditions may be summarized by the following generality; patients with small degree esotropia cannot be treated, and patients with small degree convergent fixation disparity usually need not be treated.

This generalization results from a more critical review of treatment armamentarium in these cases. Surgical treatment of either type usually results in a return or drift toward the original small convergent deviation, probably because of the easily accessible suppression area.

Young patients with a small degree of convergent fixation disparity, especially if associated with a moderate or high corrected hyperopic refractive error, usually lose much of the fixation disparity with time and full fusion frequently results without treatment. This may be hastened by the addition of orthoptics in acceptable patients, but often it may be considered a self-limiting entity.

Visual adults with significant amounts of convergent fixation disparity may be symptomatic as in any esophoria. Assignment of significant symptoms to esophoria varies greatly with clinicians. It is my opinion that adults with symptomatic esophoria are much less frequent than commonly supposed. Such infrequently occurring symptomatic patients may be treated by a trial of base-out prisms. Alleviation of symptoms by such a technique may indicate that a residual esophoria exists, not entirely compensated by foveal suppression, necessitating employment of a divergent fusion movement for single binocular vision.

From this discussion it should be recognized that some patients with esophoria may be fully adapted through sensory suppression to the motor positioning of the eyes, with the result that there is no residual uncompensated esophoria and therefore no demand for divergent fusional impulses. Such a case needs no treatment and would not benefit from base-out prisms, as might a patient with a residual uncompensated esophoria.

The prescription of base-out prisms or orthoptics for patients with small-degree esotropia is of no symptomatic benefit, since these patients are asmytomatic.

In the clinical management of visual adults with heterophoria (as well as with refractive errors) a question that should be considered more frequently is whether or not any harm will result in abstaining from treatment. If no harm would occur from not treating such patients, then the only valid reason for undertaking therapy is for cosmetic improvement or for the elimination of symptoms. The visual adult with either convergent fixation disparity or small degree esotropia is usually cosmetically satisfactory and will not be harmed by either delaying therapy or abstaining from therapy. Symptoms should be logically ascribed only to occasional adult patients with a given amount of esophoria

and convergent fixation disparity of a lesser amount (not fully compensated). It should follow that treatment should be confined to this latter infrequent instance.

Orthoptists are frequently besieged by the ophthalmologist to eliminate a small residual convergent deviation of either type, assuming that because the magnitude of deviation is small, the task is of similar proportions. The contrary is true!

In general, it may be said that in visual adults with convergent deviation of less than 10 to 15 prism diopters, no harm will result in abstaining from any therapy and much feverish activity of doubtful value to the patient will be avoided. Exceptions to this general statement are as follows:

a. Patients in whom a large convergent deviation has been significantly altered by optical correction of the hypermetropia, or surgical realignment to a small convergent deviation, may benefit from orthoptic procedures during the immediate period following such alteration, because of the state of sensory flux existing during this period.

b. Visual adults with symptomatic esophoria as already discussed.

The lack of value in the treatment of most cases of either type of anomaly needs emphasis. This was ably stated in 1936 by Pugh. When discussing such cases she remarked, ". . . it is doubtful whether the end result is worth the trouble, and this must be left to the patient to decide. As stated above, he gains very little for the expenditure of a great deal of application and a considerable amount of time may be ill spared in a busy life."[16]

Almost 20 years later, a renewed and lively interest in these cases prompted various technique of management, but with conclusions similar to those of Pugh. In 1951, Gittoes-Davies states "it is obvious that, in the type of case under consideration, the present methods of treatment are not altogether successful."[17] This conclusion was subsequently modified[18] by the same author, which elicited a lively response from four orthoptists[19] who debated the pros and cons of management in these cases.

It is my opinion that Pugh's excellent statement of almost two decades ago, already quoted, needs re-emphasis at this time.

The importance of studying the differential characteristics of these conditions rests with the theoretical implications regarding the pathogenesis of convergent strabismus, and in comparing sensory motor characteristics with those found in divergent strabismus. It is of prognostic interest to realize that patients with convergent fixation disparity frequently overcome the anomaly with time alone and develop stable fusion, while patients with small degree esotropia remain so permanently.

## Summary

Fixation disparity is the amount by which the visual axes miss exact intersection at the point of regard during single binocular vision. It belongs primarily to the classification of heterophoria but may occupy an intermediate status between heterophoria and heterotropia.

Objective cover tests differentiate the two conditions in only a single given example. Subjective sensory tests likewise do not clearly differentiate them.

The physiologic basis of convergent fixation disparity is discussed with especial reference to its laboratory determination and that existing in the state of nature.

Patients with a small degree of esotropia usually cannot be successfully treated. Patients with a small degree of convergent fixation disparity usually need not be treated.

The importance of studying the differential characteristics of these states rests in increasing knowledge of the differential pathogenesis of convergent and divergent strabismus.

The study is confined to convergent ocular deviations since similar diagnostic studies do not pertain to divergent ocular deviations.

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# H-R-R PSEUDO-ISOCHROMATIC PLATES*

## As a diagnostic aid in retrobulbar neuritis of multiple sclerosis


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Temporary loss of vision was first recognized as a symptom of multiple sclerosis by Parinaud[1] in 1884, according to McAlpine and co-authors. The frequency of retrobulbar neuritis as a sign in multiple sclerosis was demonstrated almost simultaneously by Adie,[2] Traquair,[3] and Symonds[4] in 1930. Benedict[5] reported 225 cases of retrobulbar neuritis; in 155 the condition was thought to be due to multiple sclerosis. Lillie[6] studied 500 patients with multiple sclerosis and discovered that in 15 percent optic neuritis was the primary episode. Optic neuritis occurred subsequently in another 35 to 40 percent of those patients. In a more recent study of multiple sclerosis, Taub and Rucker[7] concluded that in a patient between 22 and 40 years of age who had an attack of retrobulbar neuritis of undetermined origin the chances are 40 to 50 percent that multiple sclerosis will develop within 10 to 15 years. Thus, any aid in diagnosing retrobulbar neuritis in a patient suspected of having multiple sclerosis would be of considerable value.

In 1942 Sloan[8] first suggested the use of Ishihara pseudo-isochromatic plates in the detection of central scotomas due to lesions of the conducting pathways. It appeared that this test would be particularly useful when


* From the Section of Ophthalmology, Mayo Clinic, and the Mayo Foundation. The Mayo Foundation is a part of the Graduate School of the University of Minnesota.

applied in cases of retrobulbar neuritis in which objective findings at times are difficult to demonstrate. Consequently, for a number of years at the Mayo Clinic, Ishihara plates have been used as part of the routine examination of patients having multiple sclerosis and suspected of having retrobulbar neuritis. Since the recently published Hardy-Rand-Rittler or H-R-R pseudo-isochromatic plates are so ideally suited for this purpose, it seems appropriate at this time to emphasize the usefulness of this simple test.

## Clinical considerations

Acute retrobulbar neuritis is usually characterized by a loss of vision in one eye over the course of one to two days with a tendency toward spontaneous recovery of vision in one to two months. When the onset is rapid and progressive, complete blindness may last for a few days. Retrobulbar pain, or more often discomfort, may be present when the globe is voluntarily rotated. Temporal or generalized pallor of the optic disc usually develops about the time the vision returns. The central visual acuity may again reach 20/20 although in some cases the loss of vision persists. A relative central or paracentral scotoma may remain as a sequela of the episode.

Chronic retrobulbar neuritis is seen in association with multiple sclerosis and usually appears as a slight blurring of vision of one or both eyes. The onset is insidious and the course may be slowly progressive or remain stationary. The disturbance of vision may last days or months with complete or partial return to normal. Pallor of the optic disc usually develops with visual loss, but it may not appear until the visual disturbance has been present a month or more. The presence of a small relative central or paracentral scotoma is characteristic, but often its demonstration on the tangent screen may be difficult or impossible. The pseudo-isochromatic color plates are particularly useful in these cases when the visual acuity, optic discs, and visual fields are normal.

## Method

The new Hardy-Rand-Rittler plates are highly reliable as a screening device and as a device for qualitative and quantitative diagnosis of defects in color vision.[9] The complete test consists of a series of 20 plates. Plates 1 to 6 form the screening series which separates persons with defective color vision from those with normal vision. Plates 1 to 4 test red-green vision and plates 5 to 6, blue-yellow vision. When errors are made in the screening series, the remaining plates are usually used to determine the type and extent of the defect. However, when used for the purpose of studying cases of retrobulbar neuritis, testing with plates 1 to 6 is sufficient unless a more quantitative estimation of the defect is desired for comparison with subsequent examinations. Each plate consists of a background of gray discs on which

Fig. 1 (Steinmetz and Kearns). Sample of Hardy-Rand-Rittler (H-R-R) pseudo-isochromatic plate illuminated by a Macbeth New London Easel Lamp.

colored discs form a cross, circle or triangle (fig. 1). Either one or two symbols appear on each plate. The patient is seated 30 inches from the test book which is illuminated by a light source which has an intensity of illumination of at least 10 foot-candles. We use the Macbeth New London Easel Lamp as recommended by the publishers of the test (fig. 1).

Starting with the better of the two eyes, each eye is tested separately while the opposite eye is occluded. When each plate is exposed, the patient is asked to give an immediate response indicating the number of symbols he sees, the name of each symbol, and its location on the plate. The results with each eye are recorded and compared. Each patient should be questioned regarding any prior defect in color vision or any family history of defective color vision.

## Report of cases

### Case 1

The condition of a 46-year-old housewife had been diagnosed as multiple sclerosis in 1941, and subsequent examinations had shown slight but definite progression of the disease. In 1950 she had sudden complete loss of vision of the left eye which slowly returned to near normal in three to four months, but the vision never quite reached its previous level of acuity.

When examined in June, 1955, the vision of each eye was correctable to 20/20 and 14/14. The right optic disc was normal, but the left disc had pallor of grade 1. The visual field of the left eye had no scotoma to the one-mm. white bead but had a three-degree central scotoma to the one-mm. red target at one meter.

All H-R-R plates except the first one were read correctly when using the right eye, but the first 10 plates were missed when the left eye was used.

### Case 2

A 19-year-old predental student had experienced transient episodes of numbness of the extremities with remissions since 1953. He also described three episodes of marked clumsiness of the hands. One month before admission he awoke in the morning to find the vision of his right eye slightly blurred. It remained unchanged until three days before his examination when he thought the vision had returned to normal.

In June, 1955, the neurologic examination demonstrated intention tremor of the upper extremities of grade 1+, slightly hyperactive stretch reflexes, and diminished abdominal and cremasteric reflexes. The vision of each eye was 20/20 and 14/14. The optic discs were slightly full structurally but had normal color. Peripheral visual fields were normal and no central scotoma could be detected with either white or colored test objects.

He read all the H-R-R plates correctly except the first one with the unaffected left eye, but missed the first nine plates when using the right eye. The neurologists thought his symptoms were probably due to multiple sclerosis.

### Case 3

A 33-year-old woman was well until 1948, when she began to experience episodes of inco-ordination and paresthesias of the extremities. Each episode would last a few weeks and was followed by a remission. In 1950 she awoke one morning to find the central vision of her right eye blurred, and the next day the eye was completely blind. The vision gradually improved over a two-month period, but never became normal. In 1952, the vision of the left eye suddenly became "fuzzy," but returned to normal in a few days.

The neurologic examination in June, 1955, showed moderate inco-ordination of movements of the left hand with some loss of position sense. The vision of each eye was 20/20 and 14/14. There was pallor, grade 1+, of the right disc with a suggestion of pallor of the left. The visual fields were normal except that the one-mm. red test object at one meter appeared pink in the center of each field.

She was unable to read the first 14 H-R-R plates with the right eye, and missed the first three plates when using the left eye. Multiple sclerosis was considered the most probable diagnosis.

### Case 4

A 21-year-old girl had felt generally weak for a year prior to January, 1954, when she began to have exacerbations and remissions of paresthesias of the extremities, ataxia, diplopia, and speech difficulty. Three months prior to admission she noticed a slight nonprogressive blurring of vision of the left eye, but denied decreased vision of the right eye at any time.

A neurologic examination in June, 1955, demonstrated ataxia and a positive Romberg sign. The abdominal reflexes were decreased on the left side and bilateral movements of the hand were moderately inco-ordinated. The corrected vision of the right eye was 20/20 and 14/14 and of the left eye, 20/25 and 14/14. There was a suggestion of pallor of the right optic disc and pallor, grade 1+, of the left disc. Definite perivenous sheathing of the type seen in multiple sclerosis was present along the peripheral portion of the superior temporal vein of the right eye. The one-mm. red and blue test targets were seen faintly in the center of the left visual field but clearly in the center of the right field at one meter.

All but the first H-R-R plate were read correctly with the right eye, but the first nine plates, with the exception of plate 4, were read incorrectly with the left eye. The diagnosis was multiple sclerosis.

CASE 5

A 47-year-old woman was in good health until 1953 when she experienced a loss of vision of the left eye which developed in three days and gradually returned to normal in three months. Retrobulbar pain was present during the episode. A year before admission she noticed numbness of the left hand and forearm and a sensation of cold over the left side of the thorax. The thoracic symptoms disappeared in a month, but numbness of the extremity persisted.

In June, 1955, no objective neurologic findings were present except for slight reduction of the right patellar reflex. Corrected visual acuity of each eye was 20/20 and 14/14. The optic discs were normal without pallor and the visual fields were normal. All H-R-R color plates were read correctly with each eye. Although the history was suggestive of multiple sclerosis, no definite diagnosis was made.

## COMMENT

The color-vision defect produced by a typical case of acute retrobulbar neuritis which occurred five years previously is demonstrated in Case 1. The first 10 plates were read incorrectly when the affected eye was used, whereas, only the first plate was missed when the normal eye was used. In our experience many normal persons do not see symbols in the first plate, so this plate may be disregarded in evaluating the results of the test. In this type of case the H-R-R test only confirmed the diagnosis, since pallor of the optic disc and a small relative scotoma were present.

In Case 2 the patient had a history compatible with multiple sclerosis. Symptoms affecting the eye were suggestive of recent retrobulbar neuritis of the right eye, but the vision was 20/20, pallor of the optic disc had not developed, and the visual fields were normal. The H-R-R test furnished the only objective evidence of retrobulbar neuritis in this case when the first nine plates were read incorrectly with the affected eye and only the first plate was missed with the unaffected eye.

Each eye was involved in Case 3. The history in 1950 was that of typical acute retrobulbar neuritis of the right eye with definite pallor of the disc. In 1952 apparently the left eye was affected by retrobulbar neuritis but the pallor of the disc was equivocal. The vision was 20/20 in each eye and the fields revealed questionable central scotomas bilaterally, but were not diagnostic. Since 14 plates were missed by the right eye and three by the left, it was concluded that in a woman without a prior history of defective color vision the results warranted a diagnosis of a past episode of retrobulbar neuritis of each eye.

In Case 4 the involvement of the left optic disc was undoubted, but the problem was to decide if the suggestion of pallor of the right disc was physiologic or if it too had been involved despite the patient's denial of visual difficulty with that eye. The right visual field was normal, and she read all but the first H-R-R plate, so it was concluded that this eye probably had not been affected.

Case 5 demonstrates that in rare instances a typical history of retrobulbar neuritis cannot be substantiated by any tests including the H-R-R plates. Either the symptoms were due to some other cause or, if the episode did occur, recovery was complete.

None of the color defects demonstrated in retrobulbar neuritis fall into the classification which applies in cases of congenitally defective color vision. Thus it appears that the H-R-R color test when used for this purpose is primarily a refined test of visual acuity that is more sensitive than the ordinary black and white lettered charts and the standard methods of testing visual fields.

## SUMMARY

The new Hardy-Rand-Rittler (H-R-R) pseudo-isochromatic test for defective color vision is a simple useful aid in the diagnosis of past episodes of acute or chronic retrobulbar neuritis of multiple sclerosis. When pallor of the optic disc or other residual signs are present after an episode, the test is a dependable means of confirming the diagnosis. In cases in which the visual acuity, optic discs, and visual fields are normal, the H-R-R plates often give the only objective evidence of past involvement with retrobulbar neuritis.

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## ARE MOORE'S LIGHTNING STREAKS OF SERIOUS PORTENT?*


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A paper[6] entitled "Moore's lightning streaks: A discussion of their innocuousness," was presented in June, 1954, to the American Ophthalmological Society by Berens, Cholst, Emmerich, and McGrath. A footnote to the title states, "Aided by The Ophthalmological Foundation, Inc., and the Research Department of the New York Association for the Blind." Although not of special interest or importance to opticians, this paper was in December, 1955, reprinted in full in *Guildcraft*, published by the Guild of Prescription Opticians of America. Since it challenges Moore's belief, now prevailing, that his syndrome is not of serious portent this paper needs careful evaluation.

Before undertaking this task, it is important for the reader to know precisely the meaning of the term "Moore's lightning streaks." Since I was the first to use this term I quote from my paper[3] on the subject:

"The illusion of flashing light is a frequent symptom of certain obvious pathological conditions of the ocular fundus, particularly retinal separation. This fact is well recognized even by the textbooks. On the other hand, every experienced ophthalmologist must have encountered many patients who complained of this symptom, yet showed no fundus lesions at the time or later. So far as I know, however, the only published accounts of the illusion so occurring are the two of R. Foster Moore.[1,2] He states:[2]

" 'A symptom-complex is described which consists in the appearance of flashes of light, most frequently likened to lightning, seen to the temporal side of the eye, never to the nasal side, and vertical in direction. These flashes are accompanied by the simultaneous development of a crop of opacities in the vitreous. They seldom occur before middle age and are more frequent in the female sex. They do not imply any serious disease of the eye either at the time or subsequently. . . .'

"To identify this 'symptom complex,' and also to give credit where it is due, I believe that the condition should be designated by his name. In his first paper, Moore used the term 'lightning streaks,' in his second

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* Read before the New England Ophthalmological Society, February 15, 1956.

'lightning flashes.' I prefer the former term because it accords more definitely with the descriptions generally given by the patient."

In 1937, I developed Moore's lightning streaks in my left eye and was therefore able to discover some facts about them of which Moore was unaware, and to bring forward a reasonable theory to explain the streaks.[3] I demonstrated that they were dependent upon ocular motion, that they could at the outset be elicited not only in the temporal but also in the nasal, upper, and lower field, and that they could be elicited in the temporal field after a much longer period of time than Moore had stated. In 1942, I developed the streaks also in my right eye. Now after 18 years I can occasionally elicit a faint streak in my left eye, and after 13 years can always elicit a fairly brilliant temporal streak in my right eye. Moore developed the streaks in his right eye in 1943, in his left a year later and, in his latest paper on the subject (1947), he graciously accepts all my observations concerning his syndrome.

My theory that Moore's lightning streaks are due to ocular motion and shrinkage of the vitreous has been corroborated by slit-lamp investigations[5] and now seems to be widely accepted. It is generally taken for granted, however, that the streaks are produced by traction of the shrunken vitreous upon the retina. Apparently my view that they are produced by the shrunken vitreous striking the retina has not been accepted. My evidence for this unconventional view is that the streak is seen on the side toward which the eye is rotated and that, even when a streak is repeatedly seen for many years, retinal separation seldom if ever occurs in the affected eye. When a streak is seen in the temporal field this means that the nasal retina has been stimulated. Since after shrinkage the vitreous remains firmly attached in front of the ora serrata, my knowledge of mechanics tells me that outward rotation of the eye would cause the vitreous, if not too greatly shrunken, to strike the nasal pars optica retinae. No one has brought forward any evidence against this view, but I must admit that my evidence for it is not perfectly conclusive. At present I see no way to solve conclusively this problem, but the burden of proof is upon those who oppose my view.

In regard to the possible prognostic significance of Moore's lightning streaks, I stated[3] in 1941, "My experience thus accords with Moore's statement that subjective lightning streaks are not of serious portent. Further experience, however, is necessary before it can be stated definitely that they are entirely without prognostic significance. It would still seem wise to keep under observation any patient who complains of photopsia. In such cases, as in those of ocular injury, I frequently show the patient how to make a rough test of his visual field."

Now, however, that I have been recognizing such cases for more than 18 years, without even one of the patients returning to me later with retinal separation in the affected eye, my fear of Moore's lightning streaks has completely disappeared. In fact, I now believe that an eye in which has occurred sufficient shrinkage of the vitreous to produce lightning streaks without having caused retinal separation, is less apt to suffer this catastrophe than an eye in which such shrinkage has not occurred. In other words, I believe that, when a patient complains of lightning streaks and does not already have retinal separation in the affected eye, this danger from shrunken vitreous has largely if not wholly passed. Of course, in a few of these eyes retinal separation may no doubt later occur from other causes. Other possibilities in this connection are either too remote or too unimportant to merit discussion.

I can now return to examination of the paper[6] of Berens, Cholst, Emmerich, and McGrath. From the literature to which they refer, the authors were undoubtedly aware of the fact that lightning streaks in an eye with retinal separation or any kind of active lesion could not be termed Moore's light-

ning streaks. Yet in 23 of the 36 cases they tabulated, there were evidences of active or possibly active fundus lesions, or retinal separation, existing at the time the patients were first seen. So far as concerns Moore's lightning streaks these cases can therefore be excluded from consideration. Since, according to the title, their paper dealt chiefly with Moore's syndrome, it is not apparent why the authors did not exclude these 23 cases. Certainly these cases do not contribute anything new to our knowledge of Moore's syndrome or to that of photopsia of any kind. In closing the discussions of the paper, Berens says "I tried to limit it, as far as possible, to the syndrome Moore described." It is evident that he was highly unsuccessful in this attempt.

Of the 13 tabulated cases in which no active fundus lesions were seen, four were bilateral, so that there were 17 eyes with Moore's lightning streaks. Vitreous detachment was found in seven of these eyes, not found in seven, and not mentioned in three. Since no other cause for the streaks was noted, I feel sure that shrinkage of the vitreous was actually present in each of the 17 eyes, including the seven eyes in which it was looked for but not found.

Judging by its title and the implications in the paper it would seem that the authors are contending that Moore's lightning streaks are not "innocuous."* Yet it is difficult to be sure of this because in their conclusions the authors always refer to "lightning streaks" never to Moore's lightning streaks. However, even without using Moore's name, in the following statement they unmistakably say that his streaks are of serious portent: "Since in many instances lightning streaks precede vitreous or retinal detachment or both, . . ." As a matter of fact the authors do not provide the slightest evidence that Moore's syndrome is of serious portent for they do not record a single case in which retinal separation or any serious ocular lesion is noted to have later developed in a patient who truly had Moore's lightning streaks. They do state that ". . . but in one case retinal detachment was not seen until six months after the streaks were described. The patient had been discharged at the first examination *without having received a complete ocular* or physical examination." The italics are mine. The authors state that I reported a case in which retinal detachment later occurred but fail to state that the separation occurred in the other eye, not in the eye with which the streaks had been observed!

Another misleading statement made by the authors is: "Although lightning streaks are usually considered innocuous, it is apparently a well-established fact that retinal separation is frequently associated with this symptom." This statement is incorrect however it is interpreted. If it refers to Moore's lightning streaks, it is incorrect in stating that retinal separation is frequently associated with them. If it does not refer to Moore's streaks, it is incorrect in stating that the streaks are usually considered innocuous.

The authors state that in cases of patients who complain of lightning streaks, "Physical examination should be complete and should include laboratory and roentgen-ray studies, and a careful search for chronic infections." As nothing is said to the contrary, presumably this statement applies particularly to patients with Moore's lightning streaks, and even applies to patients with streaks due to retinal separation with hole, or to malignant melanoma. Just how these patients could be expected to benefit from such examination is not explained.

The final conclusion of the authors is, "If appropriate general treatment is instituted when lightning streaks are first seen, it is possible that some of the later complications could be minimized or prevented." If this

* Since no form of photopsia is in itself harmful to the eyes, the authors' use of the word "innocuousness" is unsuitable. Also unsuitable is their use of the work "hallucination" as a designation for the phenomenon in question.

conclusion refers to Moore's syndrome, it is unjustifiable because the authors have supplied no evidence of "later complications." If it does not refer to this syndrome, it is pointless because complications requiring suitable treatment already exist.

A statistical determination of the relative frequency of Moore's syndrome would doubtless be of value but, since no statement is made as to the circumstances under which they were collected, these 36 tabulated cases cannot be used for this purpose. I am sure that among all my patients who complained of seeing lightning streaks or flashes, not a great majority but only a small minority had fundus lesions at the time. In a study of lightning streaks it is indeed surprising that only 13 cases of Moore's lightning streaks were included. It would seem that four investigators could easily enough collect and study at least a hundred such cases.

Now that over 20 years have elapsed since Moore described his streaks, and no substantial evidence to the contrary has been brought forward, they can be accepted as having no serious portent. And judging in addition by what is now known as to their cause, they can even be accepted as constituting a good omen for the affected eye.

*395 Commonwealth Avenue.*

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## DRUSEN OF THE LAMINA VITREA

### A discussion of their difference in Europe, the United States, and China

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Common drusen of the lamina vitrea (hyaline bodies, colloid bodies) appear as a rule, as very small whitish or yellowish dots which are encountered, sometimes in small groups, sometimes as very numerous, on the posterior part of the fundus; they may be found, however, on the equator. The size equals the width of retinal vessels at the border of the papilla.

In exceptional cases some of the drusen are surrounded by a pigmented line and they may occasionally be confluent.[1] This type of drusen is found in Europe and frequently in the United States.

"Primary" drusen may be differentiated in my book from the "secondary" drusen.[2] Primary drusen are frequent in fundi otherwise quite normal and may also be found in children. The secondary drusen are much bigger, frequently confluent and less sharply outlined. They occur in all types of retinochoroiditis and they are very frequent in anatomic slides of retinal detachment due to inflammation (atrophia bulbi, and so forth).

In Europe, especially small drusen are rarely encountered; such a case is shown in Figure 1.

A woman, aged 66 years, had, O.U., with a +3.5D. sph., vision of 5/12. The left fundus showed a number of groups of small and even

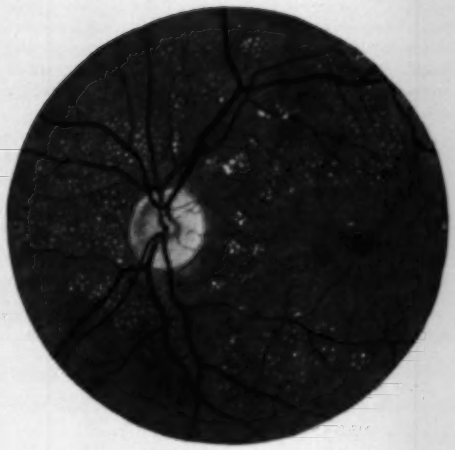

FIG. 1 (Fuchs). Unusually small drusen.

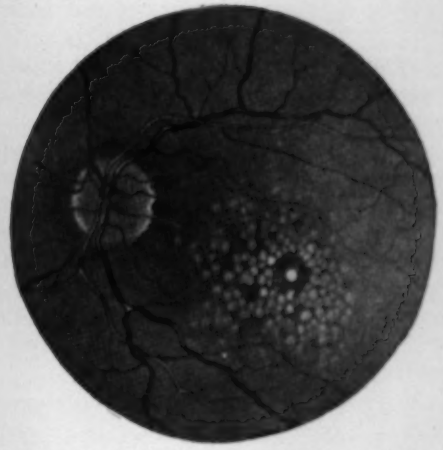

Fig. 2 (Fuchs). Drusen typical for the United States. (After Reese, A. B.: In Elwyn, H.[4])

minute whitish-yellowish dots, otherwise it was normal. The macula region was normal and free, except for a small drusen in the superior area. Specially numerous were these whitish-yellowish dots and tiny points nasal to the papilla and in the temporal periphery. The dots of the different groups varied in size, some were oblong and not glistening. The dots were smaller than the diameter of the smallest vessel in the retina and no pigmentation was present. The right fundus was normal. General examination did not reveal any pathologic condition.

The fact that the left fundus was otherwise normal and that nowhere upon the retinal vessels were dots visible made the diagnosis of drusen almost certain. Such small drusen as were present in this case I never again saw in Europe.

In the United States, in addition to drusen of the common type, I saw two cases in which the drusen were three times larger than those seen in Europe. That large primary drusen are frequent in the United States may be concluded from the following:

Elwyn[3] describes hyaline bodies of the lamina vitrea as massed together, not confluent and partly oval. In the periphery of the groups the bodies are somewhat smaller and indistinct. These bodies are described as points, or as big circular spots. They often have a diameter larger than that of the retinal vessels. Elwyn adds: "When they are small, they appear as an area of rarefied pigment epithelium; when they are large they appear elevated and may have a fine pigmented outline."

Without any doubt drusen in Europe are smaller than those demonstrated on page 192 of Elwyn's text as typical drusen.

Figure 2 comes from Reese's *Tumors of the Eye* and is the case of:

A woman, aged 56 years, who had many accumulations of hyaline bodies of different sizes over the whole periphery. The size of a large number of the drusen is mentioned as one-third to one-fourth disc diameter.

Looking at Figure 2, one realizes that these foci are much larger than drusen in Europe.

In China I found only primary drusen of the same size as I was accustomed to see in Europe. A similar type of drusen is apparently found in Japan, as Ishihara demonstrates in his *Atlas*[4] only very small drusen, corresponding to the European size.

Until now primary drusen have been discussed, that is drusen in the presence of an otherwise normal fundus. Secondary drusen are, as a rule, several times larger and are less conspicuous because of the retinochoroiditis present.

There seem to be drusen intermediate in character: lesions which are very conspicuous and accompanied by only a few pathologic changes of the fundus. Of this type I will enumerate three groups:

1. The familiar macular degeneration of honeycomb choroiditis was described by Doyne[5] (1899, 1910) and later on by Butler[6] (1910) and Mould[7] (1910). This type is characterized by a large accumulation of drusen of considerable size which are arranged like a ring around the macula. All these cases were found in the center of England.

In Vienna, I once examined two sisters with such fundus changes. Their father and grandmother were afflicted by a similar disease. The fundus of the right eye of one sister, aged 56 years, is shown in Figure 3.

The patient had pernicious anemia 13 years ago; the vision became impaired. There was dazzling and she could not read newspapers anymore. After treatment with ventremon, the condition of the blood was improved considerably and the vision became better. The sister, aged 58 years, whose blood was normal, had quite similar changes on both fundi. The posterior pole and the circumference of the papilla was occupied by numerous, whitish, sharply outlined, round discs which were of different sizes. They did not seem to be elevated. They were lying close together and in some places temporal to the macula floated together to form oblong spots. The pigment epithelium of the posterior pole was considerably rarefied so that one could see the choroidal vessels. Temporal to the macula and nasal to the papilla were irregular accumulations of pigment composed of fine black points. The papilla and the retinal vessels seemed to be normal.

Vision was: O.D., 5/60. Visual fields seemed to be normal. General examination did not reveal other changes. Vision: O.S., counting fingers at 1.5 m. The father of the patient could not read after he was 40 years old and his mother had similar troubles.

I would consider this a case of Doyne's familiar honeycomb macular degeneration intermediate in type.

2. A special group of drusen of intermediate character is represented by the following case:

A lady, aged 60 years, of Denver, Colorado, was examined in 1938. The vision in both eyes had deteriorated during the last three years and had become especially bad the last three months: O.D., 5/18; O.S., 5/12. A small central scotoma was present in both eyes. General examination did not reveal any pathologic changes.

The papilla and the retinal vessels were normal; however, the posterior pole of both eyes was covered by a large amount of not quite sharply outlined, partly reddish, partly whitish discs, over which the retinal vessels passed. These discs had a diameter three to four times larger than the large vessels. Grayish, irregularly pigmented and also whitish spots were found in the macula. Figure 4

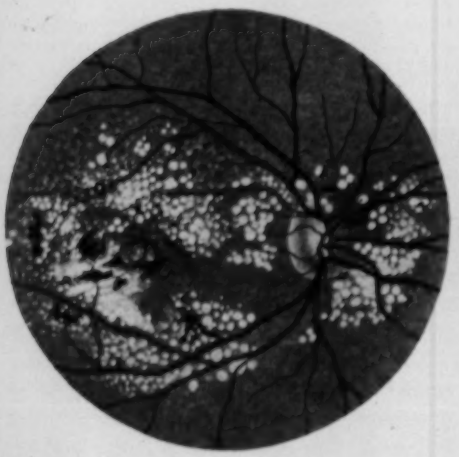

Fig. 3 (Fuchs). Familiar drusen (Doyne's honeycomb choroiditis).

Fig. 4 (Fuchs). Unusual drusen. Probably blebs between pigment epithelium and lamina vitrea.

shows the fundus of the left eye in the periphery of which there are bright whitish dots. The fundus of the right eye is shown in my book.[8]

On account of deterioration of vision during the last months the patient was treated successfully with Yatren-Casein forte and a month later the vision was raised to 5/8 and did not become worse in the following years.

I assumed that the anatomic substrate of these retinal spots was a kind of atypical drusen because spots due to clearing up of pigment epithelium are much sharper and of different color. The exceedingly slow course of the disease, the binocularity, the age of the patient, and the arrangement of the lesions at the posterior pole of the eye induced me to diagnose an atypical senile macular degeneration which was probably complicated by slight inflammation; this one could assume by the more or less sudden deterioration and the improvement of vision following therapy.

The vision remained the same during the next four years but became somewhat worse during the next six years; but even then she could read the newspaper with both eyes. When I saw the patient again, in 1948, in Denver, my examination revealed an amazing findings:

*Right eye.* The majority of the many reddish-whitish round discs in the macula region had disappeared and only very delicate little spots, like reddish and whitish reflexes, were dispersed in the macular region. The pigment in the macula had also disappeared and, somewhat temporal to the macula, a small irregular whitish spot was found, which was probably present 10 years ago. This focus was situated 0.5 disc diameters temporal from the fovea. In the fovea itself was a sharply outlined, irregular, intensely red dot about one-eighth to one-sixteenth disc diameter in size. Of the many round whitish discs which had been present in 1938, only a few were near the vena temporalis superior and a few delicate ones in the periphery near the vena temporalis inferior. Vision O.D., was nearly nil.

*Left eye.* Here, too, the large reddish-whitish discs had disappeared from the macular region. The foveal region showed whitish and reddish mottling with a few glistening points; a few of the larger discs were still present in the periphery above and temporally. Above the arteria temporalis superior were many glistening dots, which looked like cholesterol. Temporal to these were a few larger yellowish spots which had not been present before. Vision, O.S., was 6/16.

This case is remarkable first because these drusenlike discs are much bigger than those seen in Europe and, secondly, because these foci had disappeared almost completely during the course of 10 years. This made me believe that the lesions were not common colloid concretions of the lamina vitrea, as I first assumed, but were probably vesicles between the lamina vitrea and pigment epithelium which had been formed by a fluid or semifluid colloidal mass.

The case of Nitsch[9] demonstrated that such vesicles exist. A picture of this case is shown in my book.[10] The history is:

The patient had severe tuberculosis of the lungs. Recently she had suffered transient visual disturbances. Sharply outlined yellowish spots with pigmented borders had appeared in both maculas and increased in number during the last two months of life. These spots were close together and were considered as tuberculous central retinitis.

Histologically Nitsch found very flat large drusen of the lamina vitrea which had detached the pigment epithelium. The rapid appearance of these "drusen" and their flat shape, pointed at the edge, made me suspect the presence of a fluid or semifluid mass, since common drusen are usually raised over the lamina vitrea. Bedell[11] described a similar case as choriopathy.

A patient, aged 40 years, with normal vision, at first showed six pale, pink, round or oval flat areas (spots) beneath the papilla of the right eye. After three years, the vision of the right eye was somewhat diminished and the foci were less distinct, a little bigger, and more numerous. After two more years, the number had increased again and many small dots, looking like drusen but lacking "typical color and reflection," had appeared; on the outer side of the fovea point-shaped hemorrhages were noted. These hemorrhages increased and later surrounded the macula in a small arch, below and temporally.

Seven years after the first examination, the vision was 6/20; the disc was well defined—the temporal half paler with two overlying, indistinct yellow-pink spots. In the macula were fine yellow points and fine silverish weblike reflexes. A detachment of the retina in the lower half made it possible to see that the spots were confined to the choroid.

The left eye had a vision of 6/15 on first examination. Three similar yellowish, slightly indistinct spots were observed beneath the papilla,

nasally and above the macula. After three years, the disc was somewhat pale and at its temporal margin was a soft yellow white J-shaped area. The spots had increased in number. Sometime later superficial globular hemorrhages appeared beneath the macular region.

Seven years after first examination, many spots, without pigment changes, were scattered over the whole fundus; all lying beneath retinal vessels. Recent spots were smoky and indistinct but became sharply outlined later on. Above the papilla some spots were nearly as big as the papilla and somewhat V-shaped.

The visual fields in both eyes had developed a slight concentric contraction and small paracentral scotomas, apparently corresponding to retinal hemorrhages. General examination revealed no etiology.

Bedell did not think that the choroid was inflamed; however he called this disease choriopathy, although retinal hemorrhages were present; he does not mention that these rather large spots might be caused by colloid bodies of the lamina vitrea.

3. In the group of intermediate drusen I would like to classify those drusen which are encountered on the top of a nevus choroidae (benign melanoma). I had never found such a case in Europe but one was sent to me from San Francisco:

The eye doctors could not agree if the patient, a doctor, aged 64 years, had a nevus choroidae of the left eye or a beginning sarcoma (malignant melanoma). The right eye was normal, vision 5/5. The left eye (fig. 5), with a vision of 5/5 showed beneath and nasal to the papilla an indistinctly outlined slate-gray spot, somewhat larger than the papilla. The retinal vessels passed smoothly over it. In the center of this gray spot one could see many whitish small dots which were partly confluent and were, without doubt, drusen. Two small drusen were situated beneath the gray focus. The visual field showed a small retraction for red nasally and above. I could not detect a scotoma in the neighborhood of the blindspot. The ophthalmoscopic picture did not change in three and one-half years and the vision was the same, verifying my diagnosis of nevus choroidae.

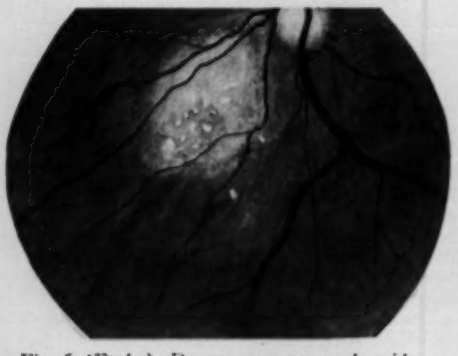

Fig. 5 (Fuchs). Drusen on a nevus choroidae.

I have seen many cases of nevus choroidae but never a case in which the nevus was covered with drusen. Johnston[12] has described different types of nevi.

In America, drusen on the surface of a nevus choroidae are rare. Reese[13] shows a nevus 2.5 disc diameters in size with two groups of drusen at the posterior pole of the eye (fig. 6). Reese says: "characteristically there are here bright, point-shaped spots dispersed over the surface which are caused by drusen of the lamina vitrea." Reese apparently has often seen drusen on the surface of nevi.

A special type of atypical drusen is represented by a peculiar fundus which I saw several times in East China. Such fundi are frequently of greenish color and appear like a starry sky; therefore I used the name starry fundus. The pigment epithelium is, as a rule, atrophic.

*Case 1.* A man of middle age had no marked atrophy of the pigment epithelium but in both eyes the choroid appeared quite naked and the choroidal vessels were clearly visible. In both the macular regions, small white irregular foci were present which apparently were not layers of connective tissue. Innumerable glistening greenish, bluish, reddish, yellowish dots were dispersed over the

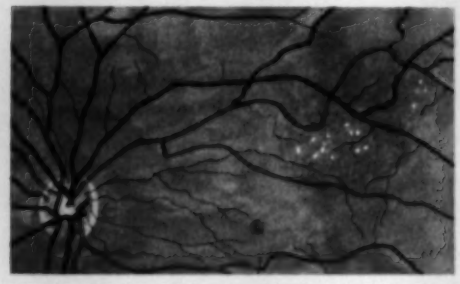

Fig. 6 (Fuchs). Drusen on a benign melanoma. (Reese, A. B.[13])

whole fundi. As they were round, they could not be cholesterol. Dr. C. H. Chou, Shanghai, who showed me this case, told me that such starry fundi are not rare.

*Case 2.* A man, aged 20 years, told me that he had been blind since birth.

Right eye. Vision was counting fingers at 3.5 m. The fundus was reddish gray. The reddish papilla was somewhat indistinct, vessels ran only to the temporal and lower quadrant, were enveloped by connective tissue, and disappeared after a short distance. On the sides of the vessels were some strands of pigment epithelium, all very indistinct. Another vessel ran a short distance directly temporally. In the temporal fundus and above and nasally there were a few indistinct pigmented spots. Below there were innumerable tiny glistening dots on top of which were distinct reflexes that were much bigger. The glistening dots appeared like twinkling stars; they were grouped together and reached to the outmost periphery in the lower nasal sector.

Left eye. Vision nil. Due to cataract it was not possible to see the fundus. There was no complaint of nightblindness.

*Case 3.* A man, aged 20 years, had had visual disturbances for three years. The papillae were not especially pale and were sharply outlined. Both fundi were of greenish color. The pigment epithelium was partly atrophic because one could see the choroidal vessels very distinctly.

Right eye (fig. 7). White glistening dots were dispersed over the entire posterior pole; one could see different groups and how they were grouped together. The fundus was greenish and most of the choroidal vessels were distinctly visible. Nasally and above, near the papillary border, there were small oblong yellowish foci and somewhat away a small pigmented focus. Still further away (1.5 disc diameters) nasally and above the papilla, some white fine streaks, apparently connective tissue, covered a choroidal vessel. Vision was 1/60 and a large central scotoma was present.

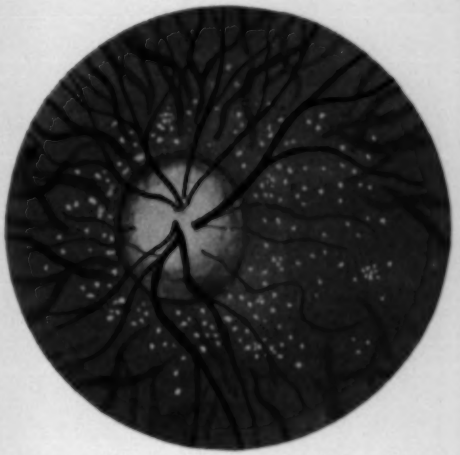

Fig. 8 (Fuchs). Starry fundus, probably drusen of the lamina vitrea.

Left eye (fig. 8). The circumpapillary area was covered by tiny, very brightly glistening dots some of which were arranged in groups. The dots were not all of the same size and were not present toward the equator. Nasal to the papilla were some oblong yellowish little foci and beyond them, one disc diameter from the papilla, nasally and above, a small indistinct pigmented focus was noted. Vision was 1/60 and a large central scotoma was present.

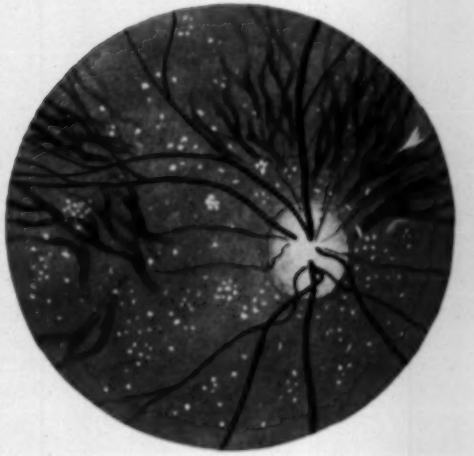

Fig. 7 (Fuchs). Starry fundus, pobably drusen of the lamina vitrea.

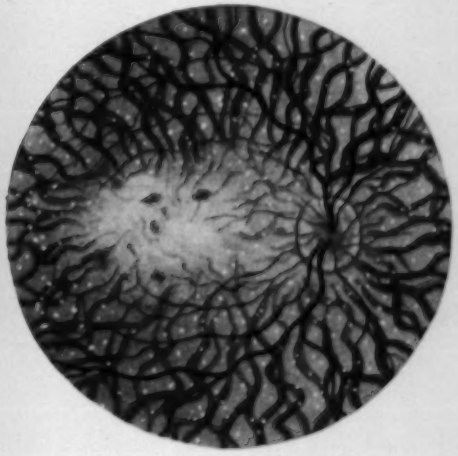

Fig. 9 (Fuchs). Starry fundus, after a picture by Liu, S.[14]

Another case was published by Dr. S. Liu.[14] Figure 9 is a copy of his picture (right eye).

A man, aged 37 years, had deterioration of vision in both eyes during the last three years. He had never had pain; Wassermann, negative. The parents were not related. He had five healthy children and four healthy sisters; only his first son had poor vision and metamorphopsia.

Vision: O.D., 0.1; O.S., 0.1 at three m.

In both eyes the papilla was pinkish and sharply outlined. The pigment epithelium showed an extensive atrophy so that the choroidal vessels became very distinct; the retinal vessels were normal. In the macular region was a large indistinct blurring in which delicate pigmented spots were found. The whole fundi were covered by glistening whitish dots which were not of equal size. There was night-blindness. Dr. Liu compared the picture of the fundus with a starry sky.

In my three cases there was no night-blindness, as there was in the case of Liu. The pigment epithelium always showed some or extensive atrophy. The papillae always appeared normal, sharply outlined, and of good color. The retinal vessels were normal.

It is difficult to form an opinion on the anatomic substrate of the glistening dots. It does not seem possible that cholesterol is deposited in drusen. No such finding was seen in specimens of primary drusen or in slides of the secondary types. Possibly drusen beneath the pigment epithelium contain special lipoids which can produce isolated glistening dots. It is not likely, however, that the glistening dots seen in China are made up of phagocytized lipoid material. I do not doubt that the dots are a type of changed drusen.

*Plantastrasse 19.*

### Addendum

Since this paper was written, a second paper by Bedell (Arch. Ophth., **52**:734 [Nov.] 1954) has come to my attention. He has changed "chorioopathy" to "choroidopathy" and reports additional cases in which large, indistinctly defined, yellowish spots, one-eighth to one-half disc diameter in size, were present, and in which central retinal changes often could be observed. Especially interesting is Bedell's case which is similar to the one illustrated in Figure 4 herein—after six years the large spots (which I call intermediate drusen) disappeared.

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# STREPTOKINASE-STREPTODORNASE*

## In the treatment of sloughing hypopyon corneal ulcers

Lalit P. Agarwal, M.S., and S. R. K. Malik, M.B.
*Agra, India*

The wide prevalence of corneal ulcers in this country and the lack of adequate medical facilities in the remote parts make corneal ulcers a formidable ophthalmic problem, contributing in a fair degree to the incidence of blindness. The therapeutics for ordinary corneal ulcers has had adequate trial with considerable success; however, the condition at the time of the first visit to the hospital is so bad in some cases that the eyes are eventually lost. With a view to better the prognosis for these eyes, the present therapeutic regime was instituted.

### Earlier work

Attempts at acceleration of healing of corneal ulcers (Agarwal and Adhaulia, 1954; Agarwal and Datt, 1953) and reducing the density of scar have been made. Recently Portfolio (1954) advocated the use of streptokinase and streptodornase in sloughing corneal ulcers on the ground that it causes rapid fibrinolysis and separation of slough. Its use in surgical ulcers of the other parts of the body is well established. He could not draw definite conclusions with regard to its effectiveness as he did not use the same antibiotic for all the ulcers under study.

### Method and material

A series of 20 cases of deep sloughing corneal ulcers with considerable hypopyon, in which the prognosis was considered hopeless, were chosen for this study. A similar series in which streptokinase and streptodornase were not given was used as control cases.

To the first group 4,000 units of streptokinase and 1,000 units of streptodornase per cc. of normal saline were given as local drops every hour for the first 48 hours and then every two hours for the rest of the period of treatment. In addition to this the patients were also given erythromycin (it was chosen because it is a broad spectrum antibiotic and covers a wide range of organisms) one-percent eye ointment three times a day and erythromycin tablets (400 mg. three to four times a day) orally for three days.

The usual atropinization and fomentation were carried out. The controls received all treatment except streptokinase and streptodornase.

### Observations

The initial clinical condition (figs. 1 and 2), the hypopyon absorption time, the slough clearing time, the healing time of the ulcer, and the type of scar formed were noted. The results are summarized in Tables 1, 2, 3, and 4.

### Discussion

The cases which were treated with erythromycin orally and one-percent erythromycin ointment and one-percent atropine ointment locally took an average of 21.2 days to heal. When the healing processes were aided by the systemic administration of vitamin A (100,000 I.U. daily), the average healing time was reduced to 15.44 days. With the systemic administration of nicotinic acid (50 mg. daily), the healing time took about 19.94 days on an average. The subconjunctival injection of nicotinic acid (50 mg. daily or on alternate days) brought the average healing time to 10 days. Almost similar results were obtained after vitamin-C administration.

No doubt these therapeutic agents con-

* From the Department of Ophthalmology, Medical College of Agra. Lederle Laboratories, Pearl River, New York, most generously supplied the streptokinase-streptodornase (Varidase) and the Eli Lilly and Company, Indianapolis, Indiana, the erythromycin (Ilotycine) used in this study.

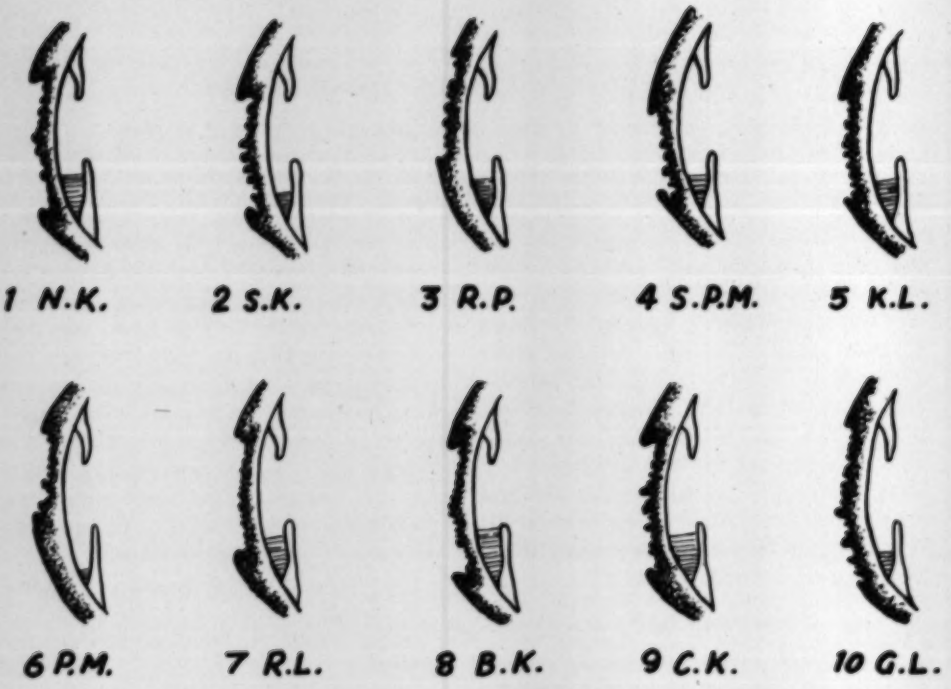


Fig. 1 (Agarwal and Malik). Appearance of corneal ulcers, Cases 1 to 10.

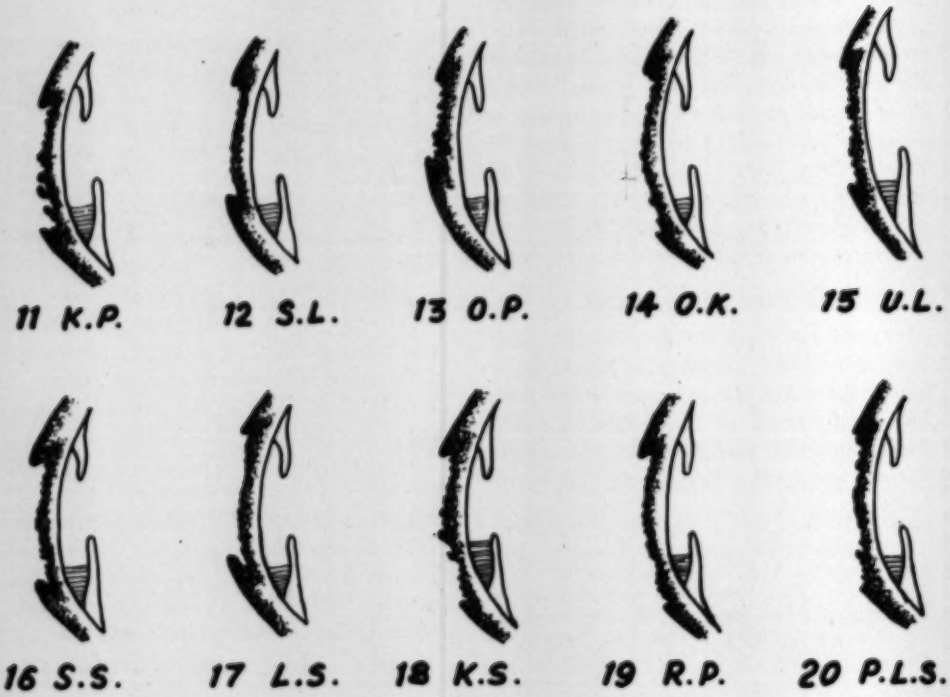


Fig. 2 (Agarwal and Malik). Appearance of corneal ulcers, Cases 11 to 20.

TABLE 1

HYPOPYON RESORPTION TIME IN DAYS

| Type | Maximum | Minimum | Average |
|---|---|---|---|
| Control | 17 | 8 | 12.75 |
| Treated with Varidase | 7 | 3 | 3.8 |

TABLE 2

SLOUGH CLEARING TIME IN DAYS

| Type | Maximum | Minimum | Average |
|---|---|---|---|
| Control | 30 | 8 | 16.15 |
| Treated with streptokinase-streptodornase | 10 | 4 | 5.8 |

siderably improved the healing time and the ultimate prognosis, yet the therapy could hardly be considered satisfactory. It was felt that if besides antibiotics and atropine therapy some agent to clear the slough was employed, the prognosis might improve and the healing time be reduced.

Slough is nothing but a necrotic fibrinous mass and organized purulent exudate containing the two basic substances fibrin and nucleoprotein. Since streptokinase and streptodornase are capable of causing lysis and dissolution of this material, they were employed to separate the slough.

Portfolio (1954) employed local drops containing 50,000 units of streptokinase and 12,500 units of streptodornase per cc. of

TABLE 3

HEALING TIME IN DAYS

| No. Type | Maximum | Minimum | Average |
|---|---|---|---|
| 1. Control | 35 | 14 | 21.2 |
| 2. Treated with vitamin A | 29 | 8 | 15.44 |
| 3. Treated with nicotinic acid | | | |
| a) Systemic | 26 | 11 | 19.44 |
| b) Subconjunctival | 14 | 8 | 10 |
| 4. Treated with vitamin C | 14 | 8 | 9.8 |
| 5. Treated with streptokinase-streptodornase | 14 | 7 | 7.93 |

TABLE 4

NUMBER OF CASES CURED WITH RESULT

| Type | No. of Cases Treated | No. of Cases Cured | Type of Scar |
|---|---|---|---|
| Control | 20 | 9 | Leukoma |
| Treated with streptokinase-streptodornase | 20 | 20 | Leukoma |

one-percent methyl cellulose. He also used subconjunctival injections of the drug. The doses employed by Portfolio are very high and are not necessary. We have obtained quite good results with 4,000 units of streptokinase and 1,000 units of streptodornase per cc. in a normal saline solution. In our cases the solution acted as physiologic debridement of an infected wound and the results fully justified its use.

That, with the use of these two enzymes, the hypopyon resorption time is very much reduced should not be considered surprising in view of the results of Jukofsky (1951) in experimental work on hyphema. Friedman (1952) was disappointed at the results in clinical cases of hyphema but perhaps the dose used by both the workers for intracameral injection was quite high, leading to complications.

It is suggested from our work that local instillation of the enzymes in the concentrations described result in their passage to the anterior chamber where they liquefy and disintegrate the hypopyon. The concentration employed is within very safe limits and the untoward reactions of Friedman are not likely. Considering that the cases treated were such that all hope of a cure had been lost, the results are astonishing. The use of these agents is strongly recommended as a routine measure in sloughing and hypopyon corneal ulcers.

## SUMMARY

1. Forty cases of sloughing hypopyon corneal ulcers are presented; in 20 streptokinase and streptodornase in 4,000 units and

1,000 units per cc. of normal saline were administered as local drops every one to two hours. Erythromycin was used as the drug of choice.

2. Eleven cases not receiving the enzymes were lost.

3. All the cases treated with these agents were saved.

4. With the use streptokinase and streptodornase the average hypopyon resorption time, the average slough-clearance time, and the average healing time were reduced.

5. The therapy had no effect on the density of the scar formed but, in view of the initial hopeless prognosis of the cases, the results are encouraging.

6. The use of these agents in doses described is recommended as a routine in sloughing hypopyon corneal ulcers.

*Medical College.*

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## OPHTHALMIC USE OF NEOSPORIN®*

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*Philadelphia, Pennsylvania*

Neosporin® is a combination of antibiotics designed for topical therapy of bacterial infections. It contains polymixin B for control of gram-negative bacterial infections,[1,2] bacitracin[3] (in the ointment preparation), or gramicidin[4] (in the liquid preparation) for gram-positive infections, and neomycin for specific elimination of Proteus vulgaris, which is highly resistant to most other agents.[5]

The aim of this study is to evaluate topical therapy with Neosporin® in external ocular infections. In most instances, an ophthalmic ointment consisting of polymixin B sulfate 0.5 mg., bacitracin 400 units, and neomycin sulfate 5.0 mg. per gm. of ointment base was used four times daily. In approximately one sixth of the cases, usually because of the patient's preference for drops over an ointment, an ophthalmic solution was instilled four times daily. The solution contained in each cc.—polymixin B sulfate, 0.5 mg.; neomycin sulfate 2.5 mg.; gramicidin 0.025 mg., in a saline vehicle. No difference was noted in tolerance or effect no matter which preparation was employed.

A total of 214 private and clinic patients was treated. To help corroborate the clinical diagnoses free use of bacterial cultures and conjunctival scrapings was made. The absence of adequate controls would make a statistical analysis of the results meaningless, consequently only a descriptive report of the results follows:

#### Acute and subacute catarrhal conjunctivitis

Thirty-five cases were included in this diagnostic group. Pathogenic staphylococci were cultured in 10 cases, nonpathogenic staphylococci in 10, B. xerosis in three, H.

* From the Research Department, Wills Hospital. Generous supplies of Neosporin® ophthalmic ointment and solution were made available to us through the courtesy of Stanley T. Bloomfield, M.D., Medical Department, Burroughs Wellcome and Company.

influenzae in two, pneumococci in one, Streptococcus viridans in one, nonhemolytic streptococci in one, S. marcescens in one, no growth in six. In two cases two different organisms were cultured. Thirty-two cases were cured or very much improved, in most instances within five to seven days. One case due to pathogenic Staph. aureus and another, with negative culture, were worse after four and seven days of treatment, respectively; the former was switched to topical Chloramphenicol therapy with resultant cure in one more week, the latter was cured in two more weeks by topical sulfonamide treatment. The one case due to nonhemolytic streptococci showed no change in culture or clinical appearance after two weeks of treatment; the subsequent addition of hydrocortisone also had no effect, but erythromycin ointment eventually succeeded. Both H. influenzae cases (in one of which Staph. albus was also found) were made bacteriologically sterile and clinically cured in seven days.

### Chronic catarrhal conjunctivitis

This group was made up of 16 cases. On primary culture, eight cases were negative, nonpathogenic staphylococci were cultured in six cases, B. xerosis in three, nonhemolytic streptococci in one, pathogenic staphylococci in one, and Ps. aeruginosa in one. In four cases, two different types of bacteria were found in the primary cultures. In 12 of the 16 cases, repeat cultures were obtained after treatment and all were rendered bacteriologically sterile except one originally negative culture which changed to nonhemolytic streptococci. After treatment for an average duration of seven days, five cases were not improved and 11 cases were improved or cured. The one case due to gram-negative bacterial infection (Ps. aeruginosa) occurred in an anophthalmic socket and was listed as cured in seven days.

### Marginal blepharitis and blepharoconjunctivitis

A total of 12 cases was treated in this group. Of four due to pathogenic staphylococci three were cured in seven, 14, and 14 days, respectively, and one was worse at the end of seven days. The latter case was associated with a seborrhea of the scalp and face which later responded satisfactorily to topical sulfonamide treatment. One case due to nonpathogenic staphylococci was cured in five days. Another case due to the same bacteria plus B. xerosis did not improve after 10 days but, when local cortisone drops were added, was cured in another week. A third case in which nonpathogenic staphylococci were found also yielded pneumococci and Proteus vulgaris and was associated with a chronic meibomitis; it was much improved after seven days of treatment at which time only pneumococci were cultured. Four cases with negative cultures were all improved in seven, seven, 10, and 14 days, respectively.

### Acute hordeolum

This category comprises 12 cases of acute hordeolum, either internal or external, that were encountered. In no case did treatment exceed seven days. In six cases nonpathogenic staphylococci were cultured, in five, pathogenic staphylococci, and in one, the culture was negative. Local applications of heat were ordered as adjuvant therapy in all cases. Eleven cases were very much improved or cured within the treatment period of one week. The one resistant case was associated with chronic meibomitis and went on to chalazion formation; primary culture yielded nonpathogenic staphylococci which disappeared from culture after seven days even though clinical improvement was lacking.

### Superficial punctate keratitis and marginal corneal ulcer

In 19 cases with this diagnosis nonpathogenic staphylococci were cultured in eight, pathogenic staphylococci in four, alpha hemolytic streptococci in one, Proteus vulgaris in one, B. xerosis in one, and negative culture in seven. Two different types of bacteria were found in each of three cases.

Sixteen cases reverted to or maintained negative or innocuous cultures and were clinically improved after an average of eight days of treatment. Two cases with negative cultures and one case with nonhemolytic Staph. aureus showed no change after two weeks of treatment and were, consequently, listed as failures. Of particular interest was the one case in which Proteus vulgaris and alpha hemolytic streptococci were cultured; in seven days complete clinical and laboratory cure was effected.

### Chronic dacryocystitis

This group included two congenital and four adult cases. In addition to topical therapy digital expression of the tear sacs was ordered for the congenital cases. From the first of these was cultured nonhemolytic streptococci and staphylococci and from the second nonhemolytic staphylococci. Both cases were clinically and bacteriologically clear in 22 and six days respectively. Two adult cases had negative cultures and were improved in five and seven days, respectively. One adult case, from which were cultured nonhemolytic streptococci and staphylococci, showed no improvement clinically or in cultures after 10 days of treatment and was eventually obliged to undergo surgical correction of the accompanying dacryostenosis. In the final adult case beta hemolytic streptococci were found and prophylactic surgery prior to cataract extraction was refused; drop treatment for seven days, aided by several lavages of the lacrimal passages with the same solution, resulted in sterile cultures and uneventful cataract surgery.

### Acute follicular conjunctivitis

Of four cases treated in this category, two of the Beal type with negative bacterial cultures showed no improvement after 10 and 14 days respectively. A third case, from which pathogenic staphylococci were cultured, was improved in seven days. The last case yielded a culture of nonpathogenic staphylococci and, after five days, developed a severe conjunctival reaction. Treatment was then switched to Chloramphenicol and cortisone drops which effected a definite improvement in two more days.

### Epidemic keratoconjunctivitis

One patient with this disease came for the first time two weeks after onset of symptoms and showed remarkable improvement after five days of treatment with the drops.

### Herpes-simplex conjunctivitis

The one patient with this diagnosis had a follicular conjunctivitis in association with two herpes-simplex lesions of the skin of the upper lid. There was a grossly visible but not tender preauricular adenopathy. No keratitis was present. Nonhemolytic streptococci and B. xerosis were found in the culture. The conjunctivitis cleared in four days on drop treatment. The lid lesions cleared in about 10 days.

### Vaccinia

A 15-month-old child developed vaccinial lesions of the skin of one upper lid soon after the appearance of a primary vaccination on the arm. There was no involvement of the conjunctiva or cornea. Neosporin® ointment was applied liberally and chlortetracycline (125 mg. every six hours) was ordered. A complete cure resulted in seven days.

### Central corneal ulcers

This group includes two infected cases and nine clean posttraumatic ulcers. One of the infected ulcers yielded nonpathogenic staphylococci and was cured in two weeks. The other case was due to hemolytic staphylococci, beta hemolytic streptococci, and H. influenzae; after one week of treatment, it was much improved, although H. influenzae was still present. Of the nine clean posttraumatic ulcers, five resulted from fingernail abrasions and the others from miscellaneous objects. All received Neosporin® prophylactically and obtained uncomplicated prompt healing.

### Alkali burns of cornea and conjunctiva

Seven cases with varying amounts of corneal and conjunctival involvement were kept free of infection and were healed in an average of five days, the extremes being three and 14 days.

### Impetigo

One case of impetigo of the lids with conjunctivitis from which Proteus vulgaris was cultured was much improved after seven days of treatment; culture then showed B. subtilis.

### Infectious eczematoid dermatitis

One such case previously resistant to local Chloramphenicol therapy was associated with marginal corneal infiltrates and negative culture. It cleared in seven days but relapsed in two weeks only to disappear permanently after two more weeks of renewed treatment.

### Phlyctenular conjunctivitis

Two cases of phlyctenular conjunctivitis were treated. The culture in one case was negative and this case was much improved after four days of treatment. Nonpathogenic staphylococci were found in the other case, which was cured after five days of treatment.

### Prophylactic treatment

In 63 eyes, the ointment was used after removal of corneal or conjunctival foreign bodies, after minor lid or conjunctival surgical procedures and after lacrimal probing. All these eyes remained free of unusual irritation or secondary inflammation. Eleven cataracts (not including the one case reported above in the chronic dacryocystitis group), seven glaucoma, and four strabismus patients received the local treatment for varying periods of time (two days to one week) prior to surgery. None of these cases developed a postoperative infection.

### Local reactions

Five cases out of the grand total of 214 experienced mild to moderate burning of the eyes after application of the ointment but none of them was obliged to stop treatment because of this reaction. Only one other case (described in the acute follicular conjunctivitis group) developed severe conjunctival hyperemia and edema which necessitated termination of the treatment. This constitutes a low reaction rate of 0.5 percent.

### Summary

Neosporin® ointment or solution was used in 214 cases of actual or potential external ocular infections. It was successful in most instances of gram-positive infections and in all seven cases of gram-negative infection. Most viral infections encountered improved during the course of therapy. The local reaction rate was 0.5 percent.

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# NOTES, CASES, INSTRUMENTS

## KERATOPLASTY WITH PUNCH FORCEPS

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Defective cutting which results in the irregular shape of both trephination and graft is one of the main reasons for postoperative complications in keratoplasty. Unless there is perfect coaptation of the sides of the graft and the bed, aqueous may seep to the graft and produce opacification. Poor fixation may also be caused by improper coaptation.

When a trephine is used for cutting, the sides of the recipient bed and the graft slope from the epithelial to the endothelial surface. This sloping of the sides is, I believe, a frequent cause for protrusion of the graft.

Since Michaelson adequately describes these difficulties, they need no further elaboration here. Apparently, however, it is almost impossible to get an ideal incision for keratoplasty with a trephine.

The ideal cutting instrument for keratoplasty must give a graft and recipient bed of the same size and with perpendicular sides. Descemet's membrane and the endothelium must be clean cut, without fringes and irregularities. Lens and iris must be protected from injury during the operation. It would seem that the instrument most capable of giving these results would be a

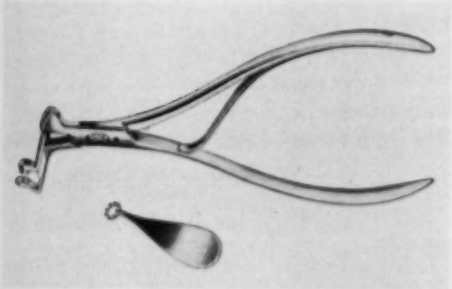

Fig. 1 (Sjøgren). The punch forceps and marker. The marker with a diameter two mm. greater than that of the punch has eight small hooks which when pressed on the cornea make small holes in the outer layer permitting exact centering of the operative field and facilitating passage of the needles.

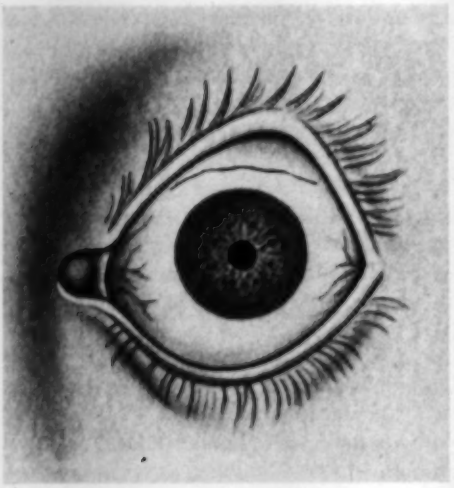

Fig. 2 (Sjøgren). An incision is made in the conjunctiva about three mm. from the limbus. Eight holes are made in the outer layer of the cornea with the marker and colored with bengal rose or fluorescein.

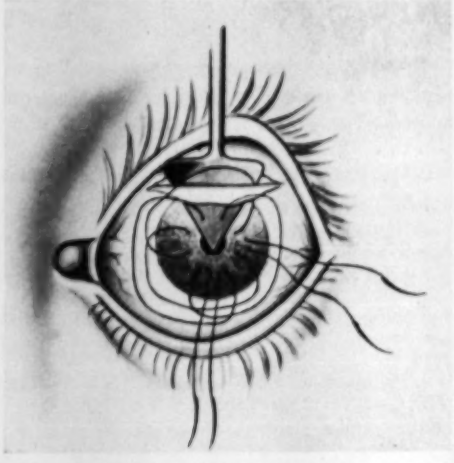

Fig. 3 (Sjøgren). Two figure-of-eight sutures are inserted in the cornea. The chamber is opened with a keratome.

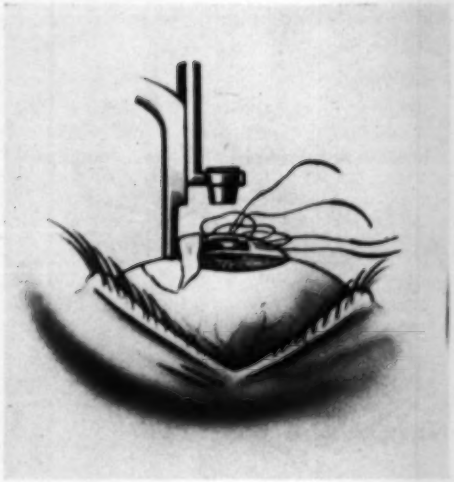

Fig. 4 (Sjøgren). The punch is inserted in the chamber and a central disc is cut out.

Fig. 5 (Sjøgren). Graft in position; sutures tied.

punch with a sharp edge, with both jaws meeting absolutely perpendicularly, with no rotating hinges to throw them off a straight line. I believe I have constructed such an instrument.

Filatov and Marzinkowsky have already designed a punch forceps for keratoplasty. Although I have never seen their instrument, from its illustration in Arruga's *Ocular Surgery*, I would say that it could not meet the requirements for an ideal instrument. Wiener, too, has designed a corneal punch but, to my knowledge, it has no sharp edges and bevels the sides of graft and bed. Pittar's punch forceps may be used only on the recipient cornea, after a Saemisch section of the corneal center. As far as I know, no other such instruments have been described in the literature.

Figures 1 through 5 demonstrate the technique of the operation. Figure 6 shows the result in the first case in which the new punch was used. The instrument is manufactured by Stille-Werner, Stockholm, and is available in diameters of 3, 4, 5, 6, and 7 mm.

Fig. 6 (Sjøgren). The first case operated with the new punch. A perfectly clear graft in a totally sclerosed cornea.

The smallest size is used mainly for the penetrating transplantation or the interchange techniques. For penetrating keratoplasty by rotation, an oblong punch, 4.0 by 7.0 mm., is available.

*Central Hospital.*

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# SUTURING CORNEOSCLERAL-CONJUNCTIVAL FLAP

## IN CATARACT EXTRACTION

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The principal techniques of corneoscleral-conjunctival suturing in cataract extraction were summarized in 1949. The objective of this presentation is to describe the type of suture which is used at present and which I consider the best. For three years I have been using two types of a subconjunctival suture, designated as techniques 4 and 5.*

Virgin silk, composed of seven cocoon threads held together by its own substance, called sericin, is used. Because of the extreme fineness of the thread and in order to increase its visibility, it is tinted with methylene blue; this identifies the suture in the surgical field.

The needles are specially constructed for this silk (Grieshaber, No. 83). They are four-mm. long, and the eye of the needle is appropriate for the size of the silk. The point and edge of the needle are similar to needles 81/5 and 81/6. The thickness of the needle is reduced proportionately.

The needles are held with a special delicate needle holder with very fine jaws. With the usual needle holder there is risk of twisting or notching the needles and destroying their usefulness.

### TECHNIQUE 4 (fig. 1)

Lifting the conjunctival flap the needle is passed through the small scleral tongue which was made for this purpose; then the needle is passed through the scleral lip of the wound, seeing to it that the points of entrance and exit of the suture are apposed in position and depth. For greater precision it is well to pass the needle through both lips of the wound at one time.

As should be understood from the foregoing description, the conjunctiva is not included in the suture but, after the suture is tied, the conjunctiva covers it completely.

### TECHNIQUE 5 (fig. 2)

In cases in which a scleral tongue is not made, the suture is introduced entirely intracorneally. A double-armed suture is used for this purpose. The intracorneal portion of the suture is placed first. The needle is inserted in the center of the cut surface of the corneal lip of the wound, to the right of the 12-o'clock meridian; the point of the needle emerges to the left of this meridian.

Each needle then pierces through the center of the cut surface of scleral lip of the wound, coming out on the surface of the sclera one or two mm. behind the cut edge. In order to obtain perfect coaptation, the depth and position of the points of entrance

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* Techniques devised by José I. Barraquer Moner.

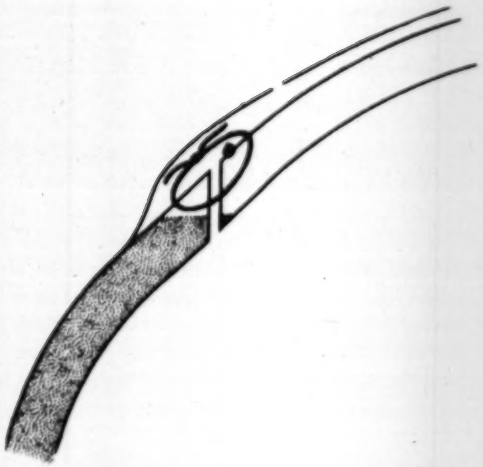

Fig. 1 (Barraquer Moner). Technique 4.

and exit of the silk must correspond exactly. A U suture results, the base of which is intracorneal and the arms intrascleral. As with the first type of suture, it is subconjunctival and produces no irritation whatever.

## Discussion

The advantages of subconjunctival sutures are obvious. Because of the absence of irritation the early postoperative course is more quiet than the postoperative course following other techniques. This material is tolerated perfectly. Since the sutures need not be extracted, an inconvenient procedure and the dangers incident to it are eliminated.

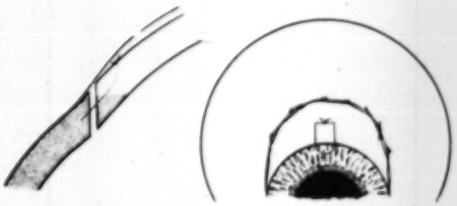

Fig. 2 (Barraquer Moner). Technique 5.

At the first dressing, on the fourth or sixth postoperative day, the eye is found quiet, without irritation, and the sutures are invisible; the methylene blue has by this time disappeared without producing any irritation, because it is an assimilable organic material.

After the sutures have been inserted it is well to fix the conjunctival flap with a solution of plasma and thrombin. To do this, the conjunctival flap is inverted over the cornea and dried with a marten-skin brush. A drop of double-concentration human plasma is then placed on it and a solution of thrombin (500 units per cc.) is instilled. The lips of the conjunctival wound are quickly united with forceps. After 15 seconds, it is well to irrigate the conjunctival sac with normal saline solution to free it of coagulated particles. The solution of plasma and thrombin not only helps to fix the conjunctival flap but, at the same time, completes what one might call calking the wound.

This suture has been used in over 600 cases without a single case of intolerance to this material having been encountered. If some point of the suture is not well covered with conjunctiva, it may be removed after 20 days when removal is no longer dangerous.

We also use virgin silk and the special needles routinely for the border-to-border sutures in keratoplasty. The fineness of the needles and suture permits the insertion of 16 sutures in a six-mm. perforating graft, with trauma reduced to a minimum and assurance of perfect coaptation. Because this silk has a minimum of foreign-body reaction, it may be left in place for 15 to 20 days without producing irritation or disturbance so that, when it is removed, the cicatrix has become firm and there is no danger of reopening the wound.

*Muntaner, 314 (6).*

## INSTRUMENT TO MANAGE CHROMIC GUT SUTURES IN OPHTHALMIC SURGERY*

ARTHUR M. YUDKIN, M.D.
*New Haven, Connecticut*

Suturing in cataract surgery was described fully in 1954 by Roper.† A number of ophthalmic surgeons have replaced silk sutures with mild chromic gut because of the complications encountered when silk sutures had to be removed from the eyes of unco-operative patients.

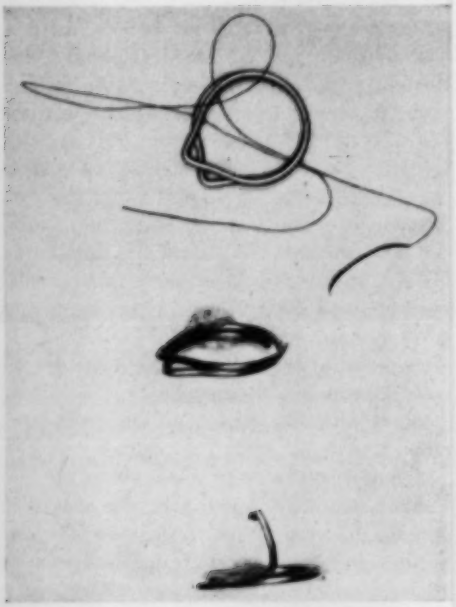

Fig. 1 (Yudkin). (Top) Clip with suture in proper position. (Center) Side view of clip. (Bottom) Side view of clip, showing sharp prong.

When I changed from silk sutures to mild chromic gut, new complications arose in the routine cataract extraction. The chromic gut suture, prepared according to instruction from the manufacturer, curled and twisted when placed in the sectioned eyeball. Working without a regular assistant made the situation very annoying. Matching the ends of the chromic gut sutures was frequently exasperating.

With the use of paper clips manufactured by the Oakville Company, Waterbury, Connecticut, I was able to control the snakey movement of the chromic gut. A free end of the clip was bent and then sharpened to a point for anchoring the clip into the eye cloth. A single surgical knot was made and the ends of the suture were placed in the protruding portion of the clip. The clip may be dropped on the eye cloth out of the field of surgery, or the clip may be anchored into the eye cloth where it is convenient for the surgeon to reach.

Recently the Ethicon Company introduced a new chromic mild gut with a very sharp needle to replace the older form of nonboilable material. The needle is very sharp and the strand of mild chromic gut is easier to control; however, I recommend the use of clips to identify the ends of the suture and thus simplify the surgical procedure.

*257 Church Street (10).*

* From the Section of Ophthalmology of the Hospital of St. Raphael.

† Roper, K. L. Suturing in cataract surgery. Tr. Am. Ophth. Soc., **52**:587-749, 1954.

## HOT-AIR STERILIZER*

### RESULTS OF MULTIPLE STERILIZATION TESTS

THEODORE N. ZEKMAN, M.D., AND
EDWARD B. LAZOR, M.D.
*Chicago, Illinois*

An improved hot-air sterilizer has been designed to prevent corrosion of sharp eye instruments which often occurs in sterilization by boiling, autoclaving, and by the use of some cold sterilizing agents. The temperature may be brought high enough for effective sterilization but still remains below the point at which the temper of sharp instruments is affected. The apparatus provides an

* From the Department of Ophthalmology, Michael Reese Hospital.

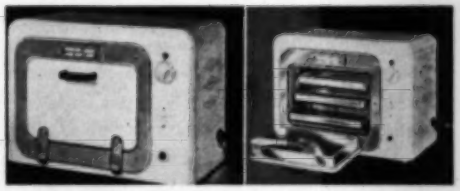

Fig. 1 (Zekman and Lazor). Exterior and interior views of hot-air sterilizer used in multiple sterilization tests with effective results.

even, automatic heat in all areas. It has fully automatic controls, including an internal timer, a visual dial type thermometer, and an indicator light. The time switch is moved into position, the time clock is set, the control switch is turned, the functioning of which is indicated by a red light, and an outside thermometer registers the inside temperature.

### Multiple sterilization tests

With the sterilizer maintained at 190°C. for one-half hour, as recommended by the manufacturer, the following species of bacteria, dried on strings of twine and placed in cotton-plugged test tubes or test tubes wrapped in a heavy-grade wrapping paper, were killed in repeated tests:

1. B. subtilis spores
2. Staphylococcus aureus (coagulase positive)
3. Streptococcus viridans
4. Pseudomonas aeruginosa
5. Proteus mirabilis

Heating at 190°C., as recommended for sterilization, did not visibly affect sharp edges of instruments on examination with a slitlamp. Only after prolonged heating in the 300°C. temperature range were discoloration and oxidative changes of instruments noted. Such prolonged and elevated heating would not normally be used.

### Conclusion

The Storz Sterilizer has the advantages of simplicity of operation and effective sterilization, apparently without deleterious changes to sharp instruments.

*109 North Wabash Avenue (2).*

### Acknowledgment

Dr. A. Milzer, bacteriologist at Michael Reese Hospital, co-operated in making the multiple sterilization tests.

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## LID RETRACTION*

### Secondary to seborrheic meibomitis: A case report

Irwin E. Gaynon, M.D.
*Milwaukee, Wisconsin*

I am recording a unique observation. It will be the first case, as far as I have been able to ascertain, in the literature.

Duke-Elder† states, "If the globe is normal in size and position, and if the margin of the upper lid rests at or above the limbus so that a band of white sclera is seen above the iris when the eyes are directed horizontally forward without staring, lid retraction exists."

Lid retraction may be physiologic, as in the staring of blindness; mechanical, as in exophthalmos, high myopia, or scarring of the upper lid; myogenic, as in Graves' disease or facial palsy; spastic, as in tabes or disseminated sclerosis; sympathetic, as in the Claude Bernard syndrome; and due to spasm with increased tonicity of the levator and Mueller's muscle.

### Case report

R. P., a white woman, aged 35 years, was referred to me on May 17, 1954, with a diagnosis of left unilateral exophthalmos of 10 months' duration. All laboratory work,

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* From the Department of Ophthalmology, Marquette University Medical School. I wish to thank Dr. F. Herbert Haessler for his help in the preparation of this paper.

† Duke-Elder, W. S.: Textbook of Ophthalmology. St. Louis, Mosby, 1952, v. 5, p. 5123.

which included repeated measurement of the metabolic rate, complete blood work, urinalysis and X-ray films of the skull and orbit, failed to reveal any abnormality. On further questioning, there was a history of intermittent photophobia, asthenopia, and a feeling of the eyes being "heavy" on arising in the morning. The lid retraction was constant and did not fluctuate.

*Eye examination:* Vision was: O.D., 20/15, 14/14; O.S., 20/15, 14/14. The palpebral aperture measured 12 mm. in the right eye and 16 mm. in the left. There was a two-mm. baring of the sclera. Repeated Hertel exophthalmometer readings were 13 for both eyes. No lid lag was present. Ocular movements were normal. The skin of the eyelids appeared normal under oblique illumination. The pupils were equal, reacted to light, accommodation, and consensually.

On slitlamp examination, a moderate white frothy secretion was noted, especially in the temporal portions of the lid margin; more severe on the left. The palpebral conjunctiva had a diffuse superficial congestion. The cornea, anterior chamber, and lens were normal. No abnormality was found in the vitreous or retinas.

The lids were expressed. An increased amount of frothy whitish discharge was removed from the tarsal glands of the left eye. Smear and culture of the secretion was positive for Staphylococcus aureus.

Refraction was: O.D., +0.25D. cyl. ax. 90° = 20/15; O.S., +0.25D. cyl. ax. 90° = 20/15. The muscle balance was normal. Schiøtz tension was: O.D., 14 mm. Hg; O.S., 14 mm. Hg. The central and peripheral fields were normal.

The patient was placed on a therapeutic routine of hot compresses, sodium sulfacetimide eyedrops, and metaphen ophthalmic ointment at bed time. Expression of the tarsal glands and subcutaneous injections of staphylococcus toxoid, according to the optimum technique of Hansel,* were instituted. The lid expressions were first carried out at weekly intervals, and finally at monthly intervals from July until November. The hot compresses and medication were carried on throughout. There was a slow and gradual improvement in the patient's condition. By the beginning of August, both palpebral apertures measured 12 mm. and the lid retraction had disappeared. Treatment was discontinued in November. The patient has been watched and there has been no recurrence of the lid retraction.

## Discussion

This is a case of lid retraction secondary to seborrheic meibomitis, chronic conjunctivitis, and chronic blepharitis. The low-grade inflammation caused a spasm of the levator and Mueller's muscle, resulting in the lid retraction. Lid expression has become a lost art since the advent of the wonder drugs. It is an excellent adjunct to modern therapy in diseases of the eyelids.

*231 West Wisconsin Avenue (3).*

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* Hansel, K. H.: Clinical Allergy. St. Louis, Mosby, 1953, p. 747.

# OPHTHALMIC RESEARCH

*Department*

EDITED BY FRANK W. NEWELL, M.D.

Abstracts of papers to be presented at the annual meeting of the Association for Research in Ophthalmology, Chicago, Illinois, June 11 to June 14, 1956

*Monday, June 11th, 1:00 p.m.*

**Reactions of the elements of retina and optic nerve in common morbid entities of the human eye.** J. Reimer Wolter, Ann Arbor, Michigan.

The changes of nervous and glial elements of human retina and optic nerve under various pathologic conditions have been studied with silver-carbonate techniques. Typical reactions could be observed and classified which were composed of hypertrophy, proliferation, and degeneration of astroglia and perivascular glia, of invasion and phagocytic function of microglia, and of different degenerative and destructive changes of ganglion cells and nerve fibers.

**Observations on the treatment of a rabbit tumor transplanted into the fundus.** Adolph W. Vogel, Philadelphia, Pennsylvania.

This study is a comparison of the effectiveness of the Stallard disc, cautery, and anticarcinogens HN2 and TEM, and combinations of these agents in destroying a tumor (V-2) of the rabbit which has been transplanted into the fundus. Studies have been done on the effect of the anticarcinogens intra-arterially administered on the normal rabbit fundus and the Stallard disc on the normal rabbit fundus. A combined transilluminator-cautery is described.

**Experiments on wound healing in the endothelium of the cornea.** Rudolf F. Binder and Hertha Binder, Cleveland, Ohio.

In order to determine the pattern of healing of defects in the corneal endothelium, experiments were performed on rabbit eyes under two conditions: (1) Only the endothelium was scraped off with a spatula without perforation of Descemet's membrane. (2) The endothelium was scraped off and Descemet's membrane was perforated.

Results: (1) The defect in the endothelium was repaired by endothelium cells alone, when Descemet's membrane was unperforated. The proliferation occurred by mitosis and amitosis of the endothelium cells. (2) If Descemet's membrane has been perforated, the repairing cells derive from the endothelium and from the stroma of the cornea (keratoblasts). (3) If anterior uveitis was caused by the experiments, inflammatory cells from the aqueous took part in the repair of the defect.

**The occurrence of lens changes following irradiation of single and multiple quadrants.** R. D. Richards, Edward Riley, and P. J. Leinfelder, Iowa City, Iowa.

Previous experiments had shown that X-irradiation of one quadrant of a rabbit lens with exposures of approximately 2,000 r had resulted in partial vacuolization of the lens limited to the area of exposure. Subsequent experiments, using exposures up to 12,000 r and irradiating either one quadrant or two opposite quadrants, had also resulted in partial vacuolization limited to the quadrants exposed. These experiments have now been ex-

tended to include irradiation of two adjacent quadrants (one half of lens) and three quadrants (three fourths of lens) in an effort to determine the proportion of a lens which must be injured to develop a complete cataract. Exposure of the entire lens to single doses of 3,000 to 7,000 r produced complete cataracts in six months or less. Irradiation of two adjacent quadrants (one half) or three quadrants (three fourths) with a single dose of 12,000 r did not produce complete cataracts in the same period of time (six months). The shielded areas have remained essentially clear.

**The effect of moderate doses of X-ray irradiation on ocular tissues.** Bernard Becker, Marguerite A. Constant, Paul A. Cibis, and Michel Ter-Pogossian, Saint Louis, Missouri.

The occurrence and persistence of an exudative process following irradiation of the rabbit's eye indicated a correlation between severity of this exudation, dose of irradiation, and inhibition of mitosis in lens epithelium. Attempts were made to modify this process.

**Clinical and experimental fungus infections of the cornea.** Albert P. Ley, Saint Louis, Missouri.

Two cases are presented in which fungi were demonstrated in pathologic sections of eyes enucleated for advanced hypopyon ulcers. The role of antibiotics and corticosteroids in experimental fungus infections of the corneas of rabbits is discussed.

**A study of strains of APC virus isolated from patients with keratoconjunctivitis.** A. Fowle, V. Simmons, and H. L. Ormsby, Toronto.

During the first six months of 1955, a number of adult patients with follicular conjunctivitis were seen and strains of virus were isolated from some of those who had corneal opacities. Clinically these opacities varied from a nebulous transient subepithelial haze to a round disclike infiltrate resembling that seen in epidemic keratoconjunctivitis. Although these clinical differences were noted, sera from these patients when tested all showed a rise in group complement-fixing antibodies of Type 3 APC virus. To test more closely for strain differences among the isolated viruses, hyperimmune rabbit sera were prepared and cross neutralization tests carried out. The results of these studies will be reported.

**Observations on experimental trachoma and inclusion conjunctivitis.** Phillips Thygeson and T. T. Crocker, San Francisco, California.

Research on trachoma and inclusion conjunctivitis has been greatly retarded by the lack of a suitable and susceptible experimental animal. Only monkeys and apes have so far been shown to be susceptible to these two related diseases and their susceptibility has been of a low order. Experimental inclusion conjunctivitis resembles the adult form of the human disease, but experimental trachoma is a self-limited follicular conjunctivitis lacking the diagnostic features of scarring and pannus. Moreover, the epithelial cell inclusions characteristic of human trachoma have not been found in the monkey disease. A further complicating factor has been the occurrence of a so-called "spontaneous folliculosis" in monkeys.

The present study was undertaken in an effort to find a reliable means of diagnosing experimental trachoma and inclusion conjunctivitis and of differentiating them from spontaneous folliculosis. It has been conducted along the following lines:

1. An attempt has been made by means of cortisone and other steroids to increase the severity of experimental trachoma so that pannus and scar-formation would be produced and inclusion become readily demonstrable.

2. An attempt has been made to employ scrapings from experimental trachoma and inclusion conjunctivitis as antigens for diagnostic purposes.

3. An attempt has been made to discover cytologic changes of diagnostic significance by the examination of (a) epithelial scrapings and expressed follicular material, and (b) biopsies.

4. An attempt has been made to show a relationship between response to therapy and diagnosis.

5. A study has been made of the comparative susceptibilities of different types of monkeys to experimental trachoma and inclusion conjunctivitis.

6. A study has been made of the etiology, clinical characteristics, and clinical course of spontaneous folliculosis.

It is hoped that the results of this study will obviate the necessity of making human inoculations, except occasionally as final, confirmatory procedures, in trachoma and inclusion conjunctivitis.

**Persistence of Toxoplasma experimentally inoculated into guinea pigs' eyes.** Michael J. Hogan, Phyllis Zweigart, and Ann Lewis, San Francisco, California.

Our observations lead us to speculate as to the method and degree of persistence of Toxoplasma in experimentally inoculated eyes. Two series of guinea pigs were studied. These animals were chosen because of the size of the eye and their relative resistance to toxoplasmic infections. Ophthalmoscopic examinations were done weekly after inoculation. The animals were inoculated intravitreally with 1:10,000 fresh, live Toxoplasma. Serologic examinations were done prior to inoculation and at variable subsequent intervals. The animals were killed and the eyes were enucleated and a portion of the choroid and retina was ground and inoculated into mice and another portion was sectioned for microscopic examination.

Of 41 inoculated animals, organisms were recovered from the tissue on mouse inoculation in 28 instances and were observed microscopically in the tissue in 18 instances. These isolations and observations occurred between the intervals of one and nine months after the initial inoculation. All animals had negative dye test titers prior to inoculation and all animals except three developed definite serologic evidence of the disease. The results will be presented so as to show the instance of recovery at monthly intervals.

After demonstrating that it was possible to recover organisms, a more carefully defined experiment was carried out. Five thousand live Toxoplasma were inoculated intravitreally in a series of guinea pigs. The dye test titers on these guinea pigs were negative. The animals were followed ophthalmoscopically and serologically up to the present time (11 months postinoculation).

The recovery of organisms was variable in the months after inoculation but up to the present period, 10th month, satisfactory recoveries have been obtained from a high percentage of the animals. For example, of eight animals killed at 10 months all eight developed chorioretinitis and all animals developed dye test titers of 1:4,000 or over. Organisms were recovered from the eyes in six of the eight animals.

We believe this experiment and subsequent ones to be carried out will demonstrate that Toxoplasma can persist in chorioretinal foci for considerable periods.

**Ocular penetration of antibiotics by iontophoresis.** S. H. Witzel, I. Fielding, and H. L. Ormsby, Toronto.

This study on rabbit eyes compares the penetration by iontophoresis of 12 antibiotics commonly used in ophthalmology with other methods of administration. Iontophoresis is effective only with those antibiotics which are in the form of elec-

trolytes. Higher levels resulted when the anode was applied to the eye with antibiotics which dissociated in such a way that the active principle of the drug was present on the anion, and from the cathode when dissociation was the reverse.

Therapeutic aqueous concentrations of erythromycin and carbomycin (medium spectrum antibiotics) were obtained by anode iontophoresis, comparing favorably with other methods of administration.

With neomycin, streptomycin, and dihydrostreptomycin, therapeutic levels in the aqueous were obtained by the usual methods of administration, but the highest concentrations were reached by anode iontophoresis.

Aqueous concentrations of penicillin were highest following cathode iontophoresis and subconjunctival injection; lower levels were obtained by other routes.

Polymyxin B and bacitracin failed to reach detectable aqueous levels by all methods.

Since no members of the broad-spectrum group of antibiotics ionize in solution, penetration by iontophoresis of chlotetracycline, oxytetracycline, and tetracycline did not occur. Chloramphenicol penetrated well by all routes and was found to reach the same levels in the aqueous when given by iontophoresis and corneal bath.

**A comparative study of scleral shortening operations in rabbits.** William G. Everett, Pittsburgh, Pennsylvania.

This paper is a comparative study in animals of the basic types of scleral shortening operations in current use for the clinical treatment of detachment of the retina. The basic operations, which represent all shortening procedures, have been listed. That is, the total penetrating sclerectomy, lamellar-scleral resection, infolded polyethylene tubing in a lamellar-scleral bed, and scleral outfolding as recently described by this author.

Operations of the above types were performed in rabbits, and survival study groups were established. The operated animals were followed for periods of four, 10, 21, and 45 days. At the completion of each operation, the procedure was rated according to its technical success. These animals were distributed through the four study periods so that no group had a preponderance of successful or unsuccessful operations. Each survival period contained four examples of each type of operation, a total of 64 procedures.

An operative protocol, listing the complications and their location, was recorded. Ophthalmoscopic examination of the fundus at the completion of the operation and at the time of killing was described. Gross descriptions of the freshly enucleated globes were made, and the globes were fixed for sectioning. Celloidin sections of each globe through the extent of the operative site were mounted for study.

An analysis of the different operations was based on the technical difficulties encountered at operation, the fundus observations, and microscopic preparations. Data in table form and Kodachrome photomicrography will be presented to illustrate the conclusions of the study. Clinical observations of the scleral folding operation, which resulted from this study, will be mentioned. A preliminary consideration of further study of this subject will be offered.

*Tuesday, June 12th, 8:30 a.m.*

**The Argyll Robertson pupillary syndrome.** Otto Lowenstein, New York.

The mechanism by which the Argyll Robertson syndrome is produced and the question of the probable anatomic site of the lesion will be discussed on the basis of:

1. Pupillographic and pharmacodynamic tests on clinical cases.

2. Evidence derived from experiments on animals.

**Studies on the autonomic innervation of the iris.** Julia T. Apter, Manteno, Illinois.

The functions of the parasympathetic and sympathetic innervation of the iris were investigated by means of action potentials. The potentials induced by physiologically evoked changes in the size of the pupil as well as by electrical stimulation of sensory nerves were recorded. Results indicate that the sympathetic innervation of the iris of cats shows no activity simultaneous with any dilation of the pupil except that concurrent with awakening. The parasympathetic ganglion on the other hand shows activity with dilation as well as with constriction. A review of other studies on this subject in the light of the present work indicates that the sympathetic nerves to the iris and sympathomimetic drugs change the size of the pupil primarily by changing the caliber of iridal blood vessels. The parasympathetic nerves change the size of the pupil by action and inhibition to the constrictor muscle. The so-called dilator muscle acts passively to allow maximal dilation and to prevent maximal constriction as a result of slow tonic impulses supplied by the sympathetic nerves.

**Some mechanisms of centrally induced eye pressure responses.** Ludwig von Sallmann, Frank Macri, Theodor Wanko, and Patricia Grimes, Bethesda, Maryland.

It has been shown that electric stimulation of the cat's interbrain in certain areas results in changes in the intraocular pressure which may be associated with effects on other autonomic regulations or may represent isolated events. In the present study attempts were made to analyze mechanisms operative in such reactions. Intraocular pressure, venous and arterial pressure, behavior of the episcleral vessels, temperature changes in the subscleral space, as well as pupillary activity, were simultaneously recorded and compared. It was shown that the occlusion of the common carotid artery during continuous stimulation causes a transient fall of intraocular pressure in the homolateral eye, followed by sustained rise to a pre-occlusion level. Subscleral temperature changes in these cases follow a pattern similar to the intraocular pressure responses. Severing of the cervical sympathetic nerves during stimulation in the sympathetic area of the diencephalon did not alter the responses of the eye pressure or the pupils. On the other hand, all stimulation effects were completely suppressed by Priscoline and Thorazine.

**Study on the innervation of the anterior chamber angle.** Monte Holland, Ludwig von Sallmann, and Eleanor Collins, Bethesda, Maryland.

In the search for effectors and receptors of central nervous impulses which might participate in the regulation of the intraocular pressure, the innervation of the trabecula of Schlemm's canal and outlet channels was investigated.

Such a study appears timely in view of the histologic observations of many nerve fibers in this area by Vrabec and Bárány's concept that the trabeculae of the eye are not a filter but are concerned with a physiology of their own. In the present investigation it was shown that, with silver-impregnating techniques, delicate nerves running into the trabecular meshwork can be seen to end adjacent to endothelial cells.

**The technique of determination of blood volume changes in the choroid and retina.** J. W. Bettman and Victor G. Fellows, San Francisco, California.

Until the present time there has never been a technique for determining changes in the total blood volume of the choroid and of the retina. In the past there have been many attempts to evaluate effects

on the blood vessels. These include direct observations of the blood vessels of the retina with the ophthalmoscope, with or without a graticule, photography with a Nordenson camera, photography with a slitlamp and Koeppe lens, and observations through the scleral window according to the technique of Leopold. Other methods include indirect estimation of the effects of change in vascularity through use of the electroretinogram by the technique of Henke, measurements of flicker-fusion frequency, and angioscotometry. None of these techniques permit of estimation of the total blood volume of choroid and retina.

The use of radioactive phosphorus permits a direct measurement of changes in blood volume of the choroid and retina. In order to use this technique, one must incubate the radioactive phosphorus into the red blood cells after a blood specimen has been drawn from the animal. Incubation and gentle agitation are carried out for two hours, the plasma and buffy coat are removed by centrifuging and the red cells are resuspended in saline and re-injected into the animal.

Measurements of the radioactivity of the blood at intervals after such an injection shows that the radioactive phosphorus remains in the blood stream for several hours. The vascularity of the sclera is negligible and that of the vitreous is nonexistent. Consequently, a Geiger-Müller tube placed over the sclera behind the ora serrata gives an indication of the blood volume under that tube. This blood volume is almost entirely contained in the retina and choroid.

The results of such studies showed great fluctuations until the investigators controlled the aeration of the animal. After intubating animals and connecting them to a breathing machine the results became constant. Variations in the carbon dioxide and oxygen content resulted in changes in the blood volume.

**Measurement of aqueous outflow in enucleated eyes.** E. W. Purnell, C. E. Melton, Jr., and E. Q. Adams, Cleveland, Ohio.

Preliminary experiments designed to study the characteristics of aqueous outflow in freshly enucleated animal eyes demonstrated the need of a sensitive method for measuring flow directly. The flowmeter constructed for subsequent experiments consists of a horizontal micropipette placed at a selected height above the cannulated eye, and connected to the eye by a flexible but inextensible plastic tube. The pipette serves as both a constant level reservoir for infusion solution and a variable resistance in a modified Wheatstone bridge. A fine wet silk thread, passing through its lumen to a beaker filled with infusion solution, maintains electrical continuity as fluid travels along the pipette to enter the eye. Changes in electrical resistance actuate a galvanometer, the excursions of which are recorded photographically. Intraocular pressure is recorded on the same film by an electronic manometer connected to the eye cannula through a three-way valve.

With this system the apparent rate of outflow in enucleated eyes increased with time after enucleation. This increase in the rate of outflow could be partially prevented if a small amount of fluid was introduced into the vitreous chamber to substitute for the vascular volume which existed *in vivo* and thus prevent deepening of the anterior chamber.

Electrical stimulation of the autonomic nerve supply to the eye caused a temporary increase in intraocular pressure and a reflux of infusion fluid back through the flowmeter, presumably because of a decrease in ocular volume. Experimental procedures to separate volume changes from changes in resistance to outflow are being investigated.

**Species variation in facility of aqueous**

**outflow.** Bernard Becker and Marguerite A. Constant, Saint Louis, Missouri.

Using the technique of anterior chamber cannulation in vivo and in vitro, estimates can be made of the facility of aqueous outflow. Values are presented for the guinea pig, cat, rabbit, and man.

**Physiologic variations of bicarbonate ion concentration in the intraocular fluids.** Harry Green and Irving H. Leopold, Philadelphia, Pennsylvania.

According to currently accepted theory, bicarbonate ion is considered to be actively transferred from the blood plasma into the aqueous humor as a result of cellular metabolic activity of the ciliary processes. Very little is known, however, of the functional dependence of the active transfer mechanism upon the plasma bicarbonate level. This investigation was, therefore, of bicarbonate ion concentration with the plasma bicarbonate level. Rabbits were continuously infused intravenously with isotonic or hypertonic sodium bicarbonate and the bicarbonate ion concentration in the anterior chamber, posterior chamber, and vitreous humor were compared with that in the plasma under steady-state conditions over a period of five hours. The results will be discussed in terms of aqueous humor dynamics.

*Wednesday, June 13th, 8:30 a.m.*

**Spectro-differential electroretinography in macular disease.** Jerry Hart Jacobson and Demir Basar, New York.

Clinical electroretinography in the past has been limited to a measure of the total retinal and, hence, predominantly rod function. This has resulted in serious limitation of the number of applications of the test. There have been four main approaches toward isolation of the macular, or cone, function from the mass response. These have been: (1) Limitation of the size of the stimulating light; this has been unsuccessful, due probably to scatter of light by the ocular media. (2) Use of monochromatic filtered light sources, making use of the differential sensitivity of the rod and cone elements to varying spectral components of "white light." (3) Use of repetitive stimulation; the difference in the flicker-fusion rate of rods and cones has been used in an attempt to separate the two functions. (4) Use of intense light adaptation of the retina in an attempt to depress rod function.

This paper deals with the attempt to differentiate rod from cone function by use of filtered monochromatic light.

By using a stroboscopic light source of extremely short duration which provided $3.2 \times 10^6$ candles we are able to obtain a stimulus strong enough, after it is passed through a deep red filter, to produce a small but definite response in normal eyes and in normal eyes with cataract. This seems to bear a definite ratio in normal retina eyes to the response to "white" light.

In 35 cases of macular degeneration of sufficient severity to reduce vision to 20/100 or less, this response to red light was either totally absent or extremely small.

In one man with a unilateral macular hole, the response was normal in the normal eye and absent in the affected one.

In the course of the work certain characteristics of the response to green light stand out in sharp contrast to the response to red. This seems to be of importance in the qualitative differentiation of the rod-cone response.

The clinical significance of this refinement of electroretinography may be great if it develops into a practical objective test of macular function.

**The effect of hallucinogenic drugs on the electroretinogram.** Julia T. Apter, Manteno, Illinois.

LSD-25 and mescaline are hallucinogenic drugs which appear, to some workers, to induce a psychosis similar to schizophrenia. Some aspects of the induced visual hallucinations, however, indicate that they may be ocular in origin and therefore are not similar to psychotic hallucinations. This hypothesis was tested by the electroretinogram in cats and in man. The studies demonstrated that spontaneous action potentials appear in the eyes of dark-adapted cats after intraperitoneal injections of LSD-25 or mescaline but not nonhallucinogenic drugs. In humans, action potentials in the electroretinogram are simultaneous with the drug-induced hallucinations. These drugs potentiate the activity of the retina so that its threshold is lowered and summation of activity markedly increased. The hallucinations, therefore, probably arise because the subject sees his own intraocular structures ordinarily not perceived and because he has a greatly amplified retinal response to any extraocular stimulus.

**Clinical studies with flicker electroretinography.** Gilbert Iser and George Goodman, Bethesda, Maryland.

The sucess obtained with subjective flicker-fusion frequency tests in revealing minimal retinal lesions suggests the study of the objective flicker-fusion frequency by electroretinographic means. Furthermore, recent experiments with the use of a high intensity flickering stimulus have shown that the resulting photopic flicker electroretinogram is primarily a response of the retinal cones. This indicates that the high intensity flicker electroretinogram may be affected abnormally by macular disease and diseases of the cone system where the single flash electroretinogram is not.

The present study was undertaken to determine whether the flicker electroretinogram would provide more diagnostic information than the standard single flash electroretinogram in retinal disease. For this purpose the electroretinographic response to single flash and flickering white light stimuli of different intensities was studied in normal patients and those with retinal pathology.

The normal human flicker electroretinogram will be discussed and the scotopic and photopic components described. Diffuse retinal disease brings about a decreased amplitude of the electroretinographic flicker waves and their fusion frequency. Finally, the value and limitations of the flicker electroretinogram will be compared to the single flash electroretinogram in clinical investigation.

**The effect of rate of rise of photic stimuli on the human electroretinogram.** Hans Bornschein and Ralph D. Gunkel, Bethesda, Maryland.

The rate of rise of a stimulus is a very important factor in electrical stimulation of the nerve. This study deals with the qualitative and quantitative changes in the components of the normal human electroretinogram, produced by varying the rate at which the light stimulus reaches its full intensity.

**Studies on the visual toxicity of methanol: IX. The effect of ethanol and methanol poisoning on the rhesus monkey.** Anita P. Gilger and Albert M. Potts, Cleveland, Ohio.

The administration of ethanol to rhesus monkeys poisoned with methanol has unquestionable therapeutic value. This is in distinct contrast to the effect of these two alcohols on lower mammals as published by us earlier. The mechanism appears to involve competition of the two substances for alcohol oxidase as postulated by earlier workers. This represents another aspect of methanol poisoning as a unique primate disease. Dosage schedules and

length of administration are most important and will be discussed in detail.

**Rod and cone vision in retinitis pigmentosa.** Bernard H. Zeavin and George Wald, Cambridge, Massachusetts.

Visual thresholds and adaptation of rods and cones have been studied in normal persons and cases of early and late retinitis pigmentosa. A special perimetric adaptometer was designed with which thresholds can be measured foveally and in any quadrant of the retina within a radius of 40 degrees. Thresholds were measured alternately in blue and orange lights, so chosen that in cone vision the threshold for blue lay *above* that for orange, in rod vision well *below* that for orange. In this way one could specify unequivocally rod or cone function, or any mixture of the two.

Visual thresholds, measured across various meridians of the dark-adapted retina, yield cross-sections (profiles) of rod and cone function within the areas of measurement. In normal persons such profiles form a peak at the fovea, descending rapidly toward the periphery. The thresholds also shift from cones to rods in a transition zone 0.5-2.0 degrees around the fixation center. In all our cases of retinitis pigmentosa the profile is inverted, the foveal thresholds forming a minimum. Associated with this change, rod vision has greatly deteriorated, most and earliest in the region within 25 degrees of the fovea, eventually also more peripherally. Cone vision also deteriorates peripherally, though much more slowly; it may appear normal in the fovea and immediate parafovea even in advanced stages of the disease, when gun barrel vision alone is present. One aberrant case exhibited normal cone vision over the whole retina, though rod vision had deteriorated completely. Pigmentation of the retina is apparent only after visual function has declined greatly.

**Residual proteins of the vitreous.** Anita Suran, and W. K. McEwen, San Francisco, California.

The residual protein of the vitreous can be fractionated into different components by mechanical and enzymatic procedures. Filtration yields a different residue than that obtained by centrifugation. Desiccation of the residual protein causes a fraction of it to become susceptible to a sequence of lytic enzymes. These differences will be elaborated and their significance to the composition of the residual protein of the vitreous will be discussed.

**Development of the orbital fascia.** Walter H. Fink, Minneapolis, Minnesota.

The presentation is a study of the orbital fascia from the early embryonic period to maturity. It is based upon a series of dissections of the human orbit, each representing a different stage of development of the orbital fascia.

The study indicates that in the early stages of development the orbital fascia is proportionally greater in amount and less differentiated than in the mature stage of development.

The various stages of development show a gradual diminution in the comparative amount and progressive differentiation of the orbital fascia into various specialized fascial structures, eventually assuming the normal appearance as seen in maturity.

The study was undertaken for the purpose of filling in some of the gaps in our knowledge of the fascial development. It may serve as a broader basis for a better understanding of anomalous fascial formations which are so important in oculomotor problems.

**Microscopy with a new illumination technique.** Paul A. Cibis, Saint Louis, Missouri.

The purpose of this paper is to describe a new miscroscopic illumination technique

which combines the advantages of substage transparent illumination with those of darkfield and surface illumination by visible or ultraviolet light. In a series of Ektochrome lantern slides the microscopic appearance of the eye structures routinely stained with hematoxylin-eosin or other staining techniques will be compared when viewed by both methods. Discontinuity zones in the lens become visible for the first time by this new method of illumination. Opportunities are now afforded for the study of lens pathology.

*Thursday, June 14th, 8:30 a.m.*

**A quantitative analysis of the horizontal movements of the eyes in the experiment of Johannes Mueller.** Mathew Alpern, Ann Arbor, Michigan.

By use of the corneal retinal potential the time characteristics of the horizontal eye movements in the experiment of Johannes Mueller have been studied. In this experiment the eye changes fixation from a far to a near object both of which fall along the same line of sight. The other eye is occluded. Movements of both occluded and nonoccluded eye have been studied with regard to latency, velocity, acceleration, form, and magnitude as a function of the separation of the far and near objects on one normal observer. Similarities and differences in the movements in looking from far to near and from near to far are analyzed. These results are compared and contrasted to results of experiments with fixation and fusional movements. Theoretic implications of these results in terms of present concepts of fusional movements, accommodative convergence, and Hering's law are discussed.

**Some physiologic considerations of hereditary macular degeneration.** Rodney D. Steinmetz and Kenneth N. Ogle, Rochester, Minnesota.

A family in which a macular degeneration is transmitted as a dominant trait has been traced through eight generations. The pedigree includes 158 individuals, 27 of whom have inherited the defect. Eleven of the 12 living affected members have been investigated by dark adaptation, critical flicker frequency, and color tests, and by visual field studies. Fundus photographs were also taken. The dark-adaptation curves revealed a decreased cone sensitivity in younger individuals, whereas the older persons exhibited a combined cone and rod degeneration. The critical flicker frequency was decreased on an average of 60 percent of normal from the fovea out peripherally as far as 30 arc degrees in all age groups. Color vision tested by the Hardy-Rand-Rittler pseudoisochromatic color plates and by the Farnsworth-Munsell 100-hue discs disclosed a general low color discrimination, with a tendency in the younger individuals toward a relatively greater loss in the perception of blue. The older patients had a very low discrimination for all colors. Visual fields as plotted on the tangent screen revealed that all subjects had a relative central scotoma. In addition, the older individuals had contracted peripheral fields. An analysis of the data according to age groups suggests that the lesion is a cone degeneration early in the course of its development, but later the rods too are affected.

**Eye movements in an adult with cerebral hemispherectomy for tumor.** David Volk and Jan H. Bruell, Cleveland, Ohio.

A case of right hemispherectomy is presented in which voluntary gaze in all directions and convergence were intact, demonstrating that normal voluntary eye movements can be accomplished by one hemisphere. Contrary to what would be expected on the basis of present concepts, in this case it was found that tonic innervation to the extraocular muscles turned the eyes toward the side of the remaining hemisphere.

**Corneal transport of lactic acid as measured with C-14 lactate.** Albert M. Potts and B. Cohen, Cleveland, Ohio.

Studies with C-14 labeled lactate indicate that material injected intracorneally enters the aqueous predominantly. When one correlates this with the known glycolytic activity of corneal stroma and its poor oxidative capacity, one may have an additional possible mechanism for maintenance of corneal dehydration.

**The hydration of the cornea: II. The influence of the epithelium and intraocular pressure.** John E. Harris, Leta B. Gehrsitz, and Louise Gruber, Portland, Oregon.

In a previous paper we demonstrated that the cornea became hydrated and its cation content approached equilibrium with the aqueous when the intact enucleated eye was refrigerated at 0°C. in a moist chamber. The changes were reversed when the eye was subsequently incubated at 37°C. The technique provides a means for studying the factors responsible for the maintenance of normal corneal hydration and cation content. The present communication is concerned with (a) the influence of the corneal epithelium and (b) the influence of intraocular pressure on the reversal during incubation at 37°C. of the changes which occur during refrigeration.

The cold-induced cation shift and hydration were not readily reversed at 37°C. when the epithelium was removed from the cornea. Various techniques for removing the epithelium were utilized, including mechanical, thermal, treatment with a caustic, and treatment with a surface active agent. The method of removal had a marked effect on the reversible shift. On the other hand, the size of the denuded area appeared to be of less significance.

The intraocular pressure was artificially altered via a cannula inserted through the optic nerve. A rather marked effect of the intraocular pressure was noted, the lower pressures favoring a dehydration of the cornea. The relation of the movement of water to that of the cations is discussed.

**Effect of castration on galactose cataract.** Robert A. Resnik and Eugene Streicher, Bethesda, Maryland.

It is known that diets containing 20-percent galactose will produce cataracts in young rats. The incidence is 100 percent in about 20 to 25 days. Mature rats are refractory to the effects of galactose. The main site of the metabolism of galactose is probably the liver and sex hormones are known to affect the activity of enzymes found in the liver.

Regarding the lens as a target rather than as a primordial site, it appeared therefore that a biochemical lesion in another organ might affect the lens. Heretofore little or no work along this line has been carried out.

Immature male and female rats were castrated. When these animals reached maturity they were placed on a 25-percent galactose diet. A group of controls were placed on the same diet. The time of onset of complete opacity was prolonged in the castrate animals.

**Enzymatic activities of lens: A preliminary survey.** Bernard Wortman and Bernard Becker, Saint Louis, Missouri.

Microbiochemical techniques developed by Dr. O. H. Lowry for the quantitative measurement of enzymatic activities in minute amounts of tissue are being adapted to the study of various parts of the eye. Glycolytic and tricarboxylic acid cycle enzymes have been qualitatively and quantitatively measured in tissues of normal rabbit lens. Lens cortex and nucleus, anterior capsule and epithelium, and posterior capsule from adult rabbits were separately homogenized in 0.05-percent bovine plasma albumin and assayed for hexose phosphate isomerase, glucose-6-phosphate dehydrogenase, aldolase, lactic dehydrogenase fumarase, and malic dehy-

drogenase by photometric and fluorometric methods. Relative importance of the conventional metabolic pathway and the hexosemonophosphate shunt may be indicated by the ratio of isomerase to glucose-6-phosphate dehydrogenase. So judged by this ratio, the activity of the shunt is low as compared with that of glycolytic as well as tricarboxylic acid pathways. Ratios of fumarase and of malic dehydrogenase to glucose-6-phosphate dehydrogenase further suggest that enzymes of the tricarboxylic acid cycle have an active role in the oxidative metabolism of lens tissues.

**Effect of age upon lens metabolism.** Harry Green, S. A. Solomon, and Irving H. Leopold, Philadelphia, Pennsylvania.

With the establishment of the Embden-Meyerhof scheme as the basic pathway of anaerobic carbohydrate metabolism in the young rabbit lens, it was desirable to determine whether physiologic aging of the lens is accompanied by disruption of the sequence of enzymatic events. Such information, it is hoped, will lead to a better understanding of the pathogenesis of senile cataract. The metabolic activity of young rabbit lens relative to the catabolism of carbohydrate was compared with that from old rabbits under optimal conditions. The results show that the capacity of the lens to produce lactic acid from glucose or from intermediary metabolites is apparently not diminished. When calculated on the basis of dry weight or weight of protein, however, the metabolic activity of the old lens is quite markedly lower than that of a young lens. The implications of these results with regard to the growth characteristics of the normal lens will be discussed.

**Enzyme systems concerned with oxidative phosphorylation in ciliary processes.** Elmer J. Ballintine and Morton B. Waitzman, Cleveland, Ohio.

Certain cyanine and styrylquinoline dyes which concentrate in the ciliary epithelium were administered in the intracarotid circulation of rabbits. The dose levels were such that there was no interference of normal oxygen consumption of ciliary processes, but there was uncoupling of oxidative phosphorylation and concomitant lowering of intraocular pressure. An investigation of the role of oxidative phosphorylation in ciliary process metabolism and its relationship to the maintenance of intraocular pressure was, therefore, undertaken.

Microanalytical methods were developed to measure oxidative phosphorylation of ciliary processes. The microphosphorus methods, which included paper chromatographic separation of very small amounts of organic and inorganic phosphorus and subsequent ashing and analyses of the isolated fractions, enabled us to detect the presence of endogenous quantities of adenine nucleotides and orthophosphate.

When similar experiments were conducted with homogenates of pigmented ciliary processes, liver, and renal cortex, the phosphorylation quotients of all three preparations were of the same order of magnitude. This high level energy output in the ciliary process system indicates the presence of a group of oxidative phosphorylation enzymes which are probably involved in active transport of fluid into the posterior chamber.

Orthophosphate accumulated when the dyes which inhibit oxidative phosphorylation were used, when the Waring blendor was used to homogenize tissue, or when nonpigmented processes were used. These conditions must result in an unbalanced enzyme system.

The presence of a substance which is inosinic acidlike appeared on incubation of nonpigmented processes. A deaminase system is, then, likely present.

**The energy requirements of the lens: The ability of various metabolites to replace glucose as substrate.** Daniel J. Heinrichs and John E. Harris, Portland, Oregon.

The energy requirements of the lens appear to be largely provided by the metabolism of glucose. Knowledge of the pathways of glucose metabolism in the intact structure is yet incomplete. The classical Embden-Meyerhof anaerobic glycolytic sequence has been demonstrated. However, the pathways by which oxygen is utilized are not known with any certainty, although both the citric acid cycle and the direct oxidative route have been postulated. One of the major obstacles to the direct study of this problem is the low oxygen uptake.

As an indirect approach we have studied an energy utilizing mechanism, the cation pump, as an index of metabolic participation. When a lens is refrigerated at 0°C., potassium leaves the lens and sodium enters. During subsequent incubation at 37°C., potassium re-enters the lens and sodium is excreted from it. The relative ability of the lens to concentrate cations is considered to provide a measure of energy production. The cation pump has been shown to require oxygen.

In the present experiments the ability to replace glucose of certain metabolites known to be intermediate in the major pathways mentioned above has been studied. Under the conditions of the experiment we have found that small lenses may maintain a cation pump for some time without added glucose. Therefore in these studies we have used lenses of a size that normally require added glucose. The substrates employed have included lactate, pyruvate, acetate, citrate, oxaloacetate, alpha-keto glutarate, gluconate, and ribose. None of the compounds tested were able to replace glucose as a substrate. (Citrate proved to be quite toxic in the concentrations used, probably due to the binding of calcium, an ion which is essential for the maintenance of normal membrane permeability.) The significance of these findings is discussed.

## Ophthalmic Miniature

The fibers of the right side of these nerves unite in the chiasm, and they go together to the cerebrum by the nerve which is in the right side of the head, and the fibers which are in the left part of such nerves, unite also in the same place, marching afterward together to the cerebrum through the nerve which is in the left part of the head, so that the two posterior nerves are united in such a manner in the cerebrum that their fibers constitute there a single image, of which the half that is in the right side of the sensorium comes from the side of the two eyes through the right side of the two optic nerves, and the half which is on the left side of the sensorium proceeds in an analagous manner from the left part of both eyes. Then the optic nerves of those animals which look at the same place with both eyes (like man, dog, sheep, ox) join into one before entering the cerebrum, while the optic nerve of those animals which do not look at the same place with both eyes (like fish and chameleons) do not unite nor mix their fibers, if I am not badly informed. (First formulation of the semidecussation hypothesis.)

Newton, Isaac: *Opticks, or a Treatise on the Reflections, Refraction, Inflections and Colours of Light*, 1704.

# AMERICAN JOURNAL OF OPHTHALMOLOGY

*Published Monthly by the Ophthalmic Publishing Company*



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## TIME TO ACT

The Committee on Public Relations of the Section on Ophthalmology of the A.M.A., of which Ralph O. Rychener, M.D., of Memphis, is able chairman, is engaged in the most difficult task of implementing the resolutions pertaining to optometry that were passed by the members of the Section and approved by the House of Delegates of the A.M.A. at its meeting in Atlantic City in June, 1955.

It is a most difficult task because it in-

volves the work of collecting information, writing reports, conducting a voluminous correspondence, and being ever alert to the possibilities of inroads into the practice of medicine by optometrists.

The biggest part of the task, which is mostly in a planning stage, is the collection and preparation of pertinent material to be used to combat legislation—that may be introduced or is being introduced in various state legislatures—which, in the opinion of physicians, is dangerous to the ocular health of the people and pernicious to the practice of medicine.

Another important function, likewise in its embryonic stage, is the preparation and dissemination to the public through various modern means of communication of just what ophthalmology is and what it does to prevent blindness.

It is obvious to most all of us that militant and aggressive action must be taken along these lines in view of the increasing aggressiveness on the part of optometry to interfere with the practice of ophthalmology and to take over some of its activities along medical lines. This is being fervently denied by some optometrists, but at the same time legislation is being sought by others among them that could be interpreted to permit them to use "drops" in the eyes, or even to treat by some way or other diseased eyes.

The committee is doing an excellent work within the limitations imposed upon it by lack of funds and support from other medical bodies. But, it needs the help of all of us in medicine.

In a recent letter to Dr. George Lull, secretary, A.M.A., Dr. Rychener points up the need for a clearing house and emphasizes that the American Medical Association headquarters is the logical place for this. He goes on to say:

"Last May (1955) the Section on Ophthalmology requested the American Medical Association headquarters to open a department to which the problems of this specialty can be funneled, with a secretary who could, in part, function as I have since that meeting. The volume of correspondence is pyramiding weekly and I am devoting three to four hours daily digesting and answering correspondence on the optometry problem, or sending advice via mail, telegraph, and telephone to state medical or special societies, attempting to aid them in coping with the spate of optometric bills, which crop up in every state legislative session. I believe this is a burden that the American Medical Association should assume."

All of us will agree, and it is up to us in our state and local societies to petition strongly the American Medical Association in this important matter.

It is suggested here, too, that the Committee of Public Relations be made a joint one, representing not only the Section, but also the American Ophthalmological Society, the Association for Research in Ophthalmology, the American Academy of Ophthalmology and Otolaryngology, and the American College of Surgeons. It should have the active support and backing not only of these organizations but also of the officers and the House of Delegates of the A.M.A. Funds must be collected and allocated to this committee to provide proper secretarial and other office help and to take care of office expenditures for the gathering and dissemination of the necessary material.

For its own protection, the American public must be kept informed on these matters so important for the prevention of blindness and the care of their eyes, no matter how difficult or distasteful to the busy ophthalmologist this job appears to be. We have, by our conservative attitude, allowed ourselves to be placed, and even duped, into a situation that may become intolerable. It is time to roll up our sleeves, open our pockets, and get to work.

Derrick Vail.

## CHICAGO CLINICAL CONFERENCE: 1956

The annual clinical conference of the Chicago Ophthalmological Society was held at the Drake Hotel on February 10 and 11, 1956. This year two symposia were presented, one on neuro-ophthalmology and one on diabetes.

Participants in the first symposium were Dr. Loyal Davis of Northwestern University, who presented a very provocative paper on "Chiasmal arachnoiditis"; Dr. Ben Lichtenstein of the University of Illinois, who discussed "Vertigo"; Dr. Douglas Buchanan of the University of Chicago, who gave a fascinating historical account of "The phakomatoses" and amply illustrated his central thesis that all the entities of this group of diseases were simply clinical variants and two or more manifestations could be found in any one patient by careful examination. Dr. Wilbur Rucker closed the symposium with a statistical study of oculomotor nerve palsies. Surprisingly enough intracranial aneurysms, a factor not even listed in many previous compilations, has become one of the chief etiologic agents of third-nerve injury. Later in the day Dr. Rucker gave the 12th annual Gifford Memorial Lecture, "Alterations in the caliber of the retinal vessels." Both these delightful papers will be printed in full shortly.

Contributors to the second symposium on diabetic retinopathy were Dr. Rachmiel Levine and Dr. Henry Ricketts of Chicago and Dr. David Rosen of Kingston, Ontario. These three papers presented the basic relationships between diabetes and the adrenal cortex and were followed by a preliminary report by Dr. Chester Coggeshall on the clinical use of the adrenal corticoids in patients with diabetic retinopathy. Dr. Coggeshall was commended for his courage, although none of the other members of the symposium felt that this treatment should be undertaken routinely at this time.

The free papers in the afternoon sessions were given by Dr. Hermann Burian, who spoke on "Electroretinography" and "Problems in the diagnosis and treatment of strabismus"; Dr. David Rosen, who discussed the effect of Ansolysin on aqueous humor formation, and Dr. Bertha Klien, who presented a series of retinal lesions, all secondary to uveitis. The final presentation was a series of movies by Dr. Ramon Castroviejo, illustrating some of his most recent techniques in cataract and detachment surgery.

It was the general feeling of the society that they had had a most nourishing ophthalmologic repast.

David Shoch.

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## WILLS EYE HOSPITAL

### Eighth annual clinical conference

The eighth annual clinical conference of the staff and the society of ex-residents of the Wills Eye Hospital, Philadelphia, was held at the hospital on February 17 and 18, 1956.

The meeting was opened with five presentations from the Research Department of the hospital.

1. Dr. Michael I. Wolkowicz, Dr. Joseph W. Hallett, and Dr. Irving H. Leopold tested 103 patients' blood serum for the presence of C-reactive protein. Their results support the prevalent opinion that in a large percentage of uveitis a connection between the uveal tract inflammation and systemic background can be established.

Their experiments conducted on aqueous humor of rabbits' eyes suggested that C-reactive protein determination might be helpful in classifying the miscellaneous group of uveitis on the basis of etiologic factors involved.

2. The second presentation concerned the effect of age on lens metabolism. This group of workers (Harry Green, Ph.D., Shirley A. Solomon, B.S., C. A. Bocher, M.S., and Dr. Leopold) compared the functional capacity of young rabbit lenses to produce lactic acid under optimal substrate concentrations with that of old rabbit lenses. They found that when cell-free extracts of the

lenses were used the ability of the older lenses to produce lactic acid was somewhat greater than that of the younger lenses. This suggested, they felt, that the aging of the lens results in a slight increase in the over-all content of enzymes responsible for carbohydrate metabolism in the lens. Although the functional capacity increased from about 40 to 100 percent, the weight of the lens increased from an average of 140 mg. to 600 mg., an increase of more than 300 percent. A proportional increase in protein content was also observed. Thus, despite, an increase in the total amount of enzyme activity, there occurs a marked decrease in the enzyme concentration, that is, the amount of enzyme activity per unit weight of lens. Whether this progressive decrease in enzyme concentration of the lens is responsible for the decreased rate of formation of new lens fibers with increased age, and leads to lens changes characteristic of senescence, remains to be established.

3. The influence of cyclodiathermy on choroidal circulation was the basis for some interesting experimental animal studies by Dr. Gerard M. Shannon and Dr. Irving H. Leopold. They studied the effect of angiodiathermy on intraocular pressure and then evaluated their results three ways. The tension was measured by a Schiøtz tonometer and the untreated eye used as a control in each animal. These animals were apparently normal animals with normal tension. The tension was recorded before application of diathermy and at appropriate intervals thereafter. At each interval when the tension was recorded, and graphed, the eye was first photographed using the scleral dehydration technique and Kodachrome transparencies recorded the changes in choroidal circulation. Secondly, the treated eyes were injected with a plastic preparation and the specimens corroded, allowing the cast to be evaluated for changes in the choroidal circulation. Lastly, a series of specimens were prepared and stained for histologic study.

The study seemed to indicate that the influence on intraocular pressure by diathermy depends on whether the arteries or veins are treated. When the veins are treated, there is a rise in intraocular pressure which may be due to edema and engorgement. This soon subsides and the tension returns to levels similar to those found preoperatively. When the arteries are treated, a transient initial rise in intraocular pressure occurs; this is less than for the veins. In a few animals a fall in tension occurred for short periods of time. When the anterior segment is deprived of its blood supply, necrosis results. It was also noted that although the blood flow is re-established in three to four weeks the ciliary body involved shows the effects of the angiodiathermy for several months.

4. Dr. Satya Dev Paul and Dr. Irving H. Leopold reported on the influence of three tranquilizing drugs on intraocular pressure in experimental animals as follows:

A. *Thorazine* (Smith, Kline & French). Thorazine in varying dosages was used in two different species of animals, and in both these species the intraocular pressure was lowered. The effect on the pupil in these two different species of animals was different.

It was observed that Thorazine had a greater ocular hypotensive effect on those eyes which had an initial higher tension.

It was suggested that the possible mechanism of action of Thorazine in lowering the intraocular pressure would be:

1. General lowering of blood pressure.
2. By possible decrease in the blood flow through the eye.
3. By some central action.

It was suggested that Thorazine might be employed as an adjuvant to glaucoma therapy. The drug is being used on the European continent as an antiglaucomatous measure.

B. *Reserpine* (Squibb). In this study the effects of Reserpine remarkably parallel effects of hypothalamic lesions, namely, ptosis and miosis with lethargylike sleep.

C. *Miltown* (Wallace). This drug lowers the intraocular pressure and was nontoxic in the doses administered.

5. Some interesting observations of lamel-

lar scleral resections performed in albino rabbits were made by Dr. E. Wudka and Dr. Irving H. Leopold. They followed their progress by microscopic and ophthalmoscopic observations.

Unfolding of the resected sclera occurred in one to two weeks after surgery.

Local and general changes of a transitory nature were observed in the choroidal circulation.

Temporary detachment of the retina occurred in the resected area. A factor in the beneficial effects of the operation they believed to be due to transitory approximation of the external ocular coats to the detached retina.

Dr. Rudolph Jaeger, consulting neurosurgeon of the hospital, spoke of eye disorders associated with surgical problems of the nervous system. He called attention to three important diagnostic aids—X rays, pneumoencephalography, and angiography.

Dr. Jaeger then spoke at some length of a new treatment for tic douloureux of the eye and face, consisting of injecting less than one-half teaspoonful of hot water into the gasserian ganglion. One hundred patients have been successfully relieved of pain by this method without a death or serious complication. Dr. Jaeger, the Wills Eye Hospital, and Jefferson Medical Center were presented with the Award of Merit for this discovery at the 1955 A.M.A. meeting.

This concluded the first morning's scientific session, affording time before lunch to visit the 26 technical exhibits set up in three large out-patient examining rooms.

Scientific exhibits appeared this year for the first time. The Research Department had an exhibit on the rationale for, and the use of, radioactive phosphorus ($P_{32}$) in the detection of tumors of the eye and its adnexa.

The second exhibit was by Dr. Jaeger and his group on the treatment of tic douloureux by injection of boiling water into the gasserian ganglion.

Color television was again featured during both days of the conference through the courtesy of the hospital's good neighbor across the street—Smith, Kline & French Laboratories.

Surgery, demonstrations, case presentations, and procedures appeared in smooth and uninterrupted sequence from 1:00 to 3:00 P.M. on Friday and 2:00 to 5:00 P.M. on Saturday. Much of the success of this feature of these annual conferences is to be credited to the co-ordinating efforts of Dr. Wilfred E. Fry.

Three papers were given during the Friday afternoon scientific session.

Dr. Robert D. Mulberger and Dr. P. Robb McDonald reported on 48 patients on whom they performed Stallard's modification of the iridencleisis operation.

Dr. Louis B. Cohen, Dr. T. F. Graham, and Dr. Wilfred E. Fry spoke of the use of beta irradiation as an adjunct to glaucoma surgery in the Negro.

Dr. James S. Shipman talked of his experience with the corneal trephine operation, which is his choice for surgery in wide-angle glaucoma.

Saturday morning's session was opened by Dr. Edmund B. Spaeth who described a plastic operation for enucleation of the eye, designed to eliminate some of the objections to current implant procedures and yet transmit motility to the prothesis. He showed a short film of the procedure.

Dr. Patrick J. Kennedy reported on the treatment of five cases of iris cysts and one case of epithelial inclusion cyst of the anterior chamber with electrolysis. He felt that the method warranted consideration, since it is not as hazardous as other methods.

Dr. James F. O'Rourke spoke of the use of Prednisone in ocular disease. Experimental studies had shown its increased potence when compared to cortisone in the treatment of ocular inflammation. Such potency, said Dr. O'Rourke, permits the use of a dose greatly reduced from that of cortisone. Treatment is also possible for a much longer period of time.

This year's Arthur J. Bedell lecturer, Dr.

Albert D. Ruedemann, Sr., was introduced by Dr. James H. Delaney, president of the Wills Eye Hospital Society. Dr. Ruedemann's lecture was on progressive bilateral exophthalmos. His interest and long exposure to the subject, including his years at the Cleveland Clinic, enabled him to give a most instructive and practical discussion of the many confusing diagnostic problems involved in this entity.

On Friday evening, an informal reception and supper were held at the Barclay for all doctors and wives. It was certainly an occasion to remember—nowhere have I tasted such delicious hot hors d'oeuvres!

The Wills Eye Hospital Society held its annual business meeting and dinner at Philadelphia's famed (Republican) Union League Club on Saturday evening. Elected officers for the coming year are: President, Dr. Warren S. Reese, Philadelphia; vice-president, Dr. Lee W. Hughes, Newark, New Jersey; and secretary-treasurer, Dr. Roscoe J. Kennedy, Cleveland, Ohio.

Kenneth L. Roper.

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## OBITUARY

### JUSTIN M. DONEGAN

### 1912-1956

Justin M. Donegan died March 7, 1956, of carcinoma of the colon after an intermittent illness of two years. He attended St. Ambrose College, and was graduated from Iowa State University in 1931. He received his M.D. degree from the University of Iowa College of Medicine in 1935 and interned in the Milwaukee County General Hospital in 1936. His residency training in ophthalmology was taken at Billings Hospital, Chicago, between 1936-39. Following this, he was associated with E. V. L. Brown in private practice and was instructor in ophthalmology at Billings Hospital, 1939-42. He then became associated with the University of Illinois College of Medicine as assistant professor and, after 1947, as associate professor of ophthalmology. In 1947, he also became chairman of the Department of Ophthalmology at Presbyterian Hospital and at St. Joseph's Hospital, Chicago. In 1953, he became a member of the American Ophthalmological Society, and in 1954 was elected president of the Chicago Ophthalmological Society. He was a member of the University Club of Chicago and the Billings Club.

Dr. Donegan represented all that is best in a clinical ophthalmologist, as attested by his large practice and devoted following of patients. He combined this with an interest in all phases of research and pursued experimental studies of arteriosclerosis in the rabbit. His lectures possessed that enviable combination of practicality, rationality, and verve which would arouse so much interest and enthusiasm in his professional colleagues and students. His selfless co-operation set a precedent for the harmonious integration of the Departments of Ophthalmology at the Presbyterian Hospital and the University of Illinois, which provided mutual advantages in the teaching of medical students and training of residents.

Dr. Donegan's untimely death was all the more saddening to his friends because of the contagious buoyancy of his personality. His reputation as a master of story telling was farflung, the ancedotes revealing his insight into the frailties of human nature and a philosophy of not taking oneself too seriously. These qualities seemed to provide him with amazing fortitude in facing the mortal problems of the last two years of his life.

Many of his friends will think of him primarily as a family man, centered in his beloved wife, Kay, and six children. As a member of the Roman Catholic Church, he supported religious activities with as much enthusiasm as we came to expect in every activity which he undertook. His warmth of personality and spirit will not be soon forgotten.

William F. Hughes, Jr.

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# CORRESPONDENCE

## True status of Hylkema's atypical achromate

Editor,
American Journal of Ophthalmology:

In 1943 Hylkema* described a young woman (designated by him "F2") who was totally color blind, but had normal visual acuity and was free of all of the pathologic symptoms of typical achromatopsia. She was reported to have had two sons, one a protanope and the other a deuteranope.

A year ago I published† an interpretation of F2 as the victim of a severe heterozygous action of one protanopia gene, eliminating one of the three color components (for which there is precedent), together with a similar action of one deuteranopia gene (for which there is also precedent). Left with one component, she could have no color discrimination.

It has transpired that this interpretation is impossible. For several years Crone, in Amsterdam, has been investigating F2's family. His study is now complete and is in press.‡ He finds F2's sons to be respectively an atypical achromate and a deuteranomalous trichromate; she also has two color-normal daughters. Among other relatives there are deuteranomaly, deuteranopia, and tritanopia standing alone and perhaps also in combinations.

My interpretation† of Weale's "J. G." as having atypical achromatopsia on the basis of one gene for deuteranomaly and one gene for extreme protanomaly, remains unaffected. But F2 apparently has genes for deuteranomaly and tritanopia, and probably only one of each. It is known that one gene for tritanopia may produce tritanopia (eliminating the blueness component), and J. G. shows that one gene for deuteranomaly may knock out the greenness component. F2's atypical achromasy is thus readily enough explained after all, and one of her sons is like herself whereas the other son did not happen to receive the tritanopia gene. Both genes did not get into either daughter—or, if they did, they are not enhancing each other's expressivity as they seem to be doing in F2.

(Signed) Gordon L. Walls,
Berkeley, California

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* Hylkema, B. S.: Klinische Anwendung der Bestimmung der Verschmelzungsfrequenz. Arch. f. Ophth., **146**:110-127, 241-252, 1943.

† Walls, G. L.: A branched-pathway schema for the color-vision system and some of the evidence for it. Am. J. Ophth., **39**:8-23; (Feb. pt. II) 1955.

‡ Crone, R. A.: Combined forms of congenital colour defects: A pedigree with cone monochromatism. Brit. J. Ophth., In press.

## So-called blindspot mechanism

I wish to take exception to Dr. Verhoeff's insulting article, entitled "The so-called blind spot mechanism" (Am. J. Ophth., 40:802, Dec. 1955) in which he attempts to prove Dr. Kenneth Swan's observations of this condition are erroneous. Whether one wishes to call it a syndrome or a mechanism, or something else, is relatively unimportant. That there is such a clinical entity can easily be proven by anyone who looks for it. To demonstrate its presence, all that is necessary is an ophthalmoscope with an ample light source, either direct or indirect, and a patient who has the condition. Proceed as follows: In the dark room, have the patient fix on the ophthalmoscope mirror, held before the examiner's eye in the position in which an ophthalmoscope is generally used. The examiner may be anywhere from one third of a meter to one and one-half or even two meters from the patient. The patient will naturally fix with the dominant, or nondeviating eye and, if the examiner will adjust the ophthalmoscope so the macula of that eye is in focus, then switch the beam into the deviating eye, he will be surprised to find the nervehead visible and sharply defined. In a typical case, even with widely dilated pupils, the image of the nervehead occupies almost the entire pupillary area and little or no retina is seen, no matter what distance the

examiner may be from the patient. The angle from which one views the phenomenon is unimportant so long as the dominant eye continues to look at the ophthalmoscope light. (This will, of course, not hold for cases that are due to paralysis of an extraocular muscle, if the ophthalmoscope is moved into the field of action of that muscle.)

The syndrome, when demonstrated in this manner, is striking. The evidence is objective, it does not depend on the often erroneous answers of a patient, as in Dr. Verhoeff's so-called A and B test, or on elaborate mathematical calculations which are subject to well-known errors. It is also very convincing when one remembers the relative area of the nervehead and of the area on which sharp vision is obtained on the macula.

It was never claimed that patients with this syndrome were very numerous. This mechanism, however, constitutes a third way in which a patient with just the right amount of esotropia can (subconsciously, of course) prevent diplopia in addition to the classical mechanism of suppression or amblyopia, used in their generally understood sense, not with some special restrictions imposed by Boston.

If one is convinced of the existence of such a syndrome, mechanism, or clinical entity, he may dismiss the rest of the trivia of which Dr. Verhoeff's article is composed.

If Dr. Verhoeff would train his popgun on those writers whose only contribution to the study of heterotropia has been to try to change the names of everything connected with the anatomy and physiology of the extraocular muscles, he would be doing a greater service than by a personal attack on the work of one of the very few authors who have contributed anything to the knowledge of the subject since Duane's monograph appeared in 1896, the publications of papers of the late James White and the writings of T. A. B. Travers.

(Signed) George N. Hosford,
San Francisco, California.

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### Dr. Verhoeff's reply

Editor,
American Journal of Ophthalmology:

Dr. Hosford terms my paper on "The so-called blindspot mechanism" "insulting." I am not aware that it is "insulting" or a "personal attack" to call attention to an author's mistakes, but this is the only possible basis for the allegation. There can be no doubt, however, that Dr. Hosford's letter is insulting to me, but on an entirely different basis, for he does not disprove anything I have said in this or any other paper.

Aside from insulting me, he points out in a roundabout way, that there are cases of esotropia in which, at least at times, the deviation is 12 degrees to 18 degrees. Nowhere have I denied this obvious fact. The purpose of my paper was to demonstrate the falsity of Dr. Swan's assertion and implications as to the importance of this fact. Dr. Hosford does not attempt to refute even a single statement that I have made, nor does he bring forward any new evidence in support of Dr. Swan's contentions. On the contrary, in his use of the word "trivia" he belittles these contentions and therefore, according to his own standards, is himself "insulting" Dr. Swan.

If Dr. Hosford will try to understand my paper, and succeeds in doing so, he will regret his display of lack of understanding in his insulting letter.

(Signed) F. H. Verhoeff,
Boston, Massachusetts.

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## BOOK REVIEWS

Experimental Tuberculosis. Ciba Foundation Symposium (London, October 1954). Boston, Little Brown & Co., 1955. Price: $9.00.

This volume is the proceedings of a symposium on experimental tuberculosis, sponsored by the Ciba Foundation for the Promotion of International Co-operation of Medical and Chemical Research. Invited to

this symposium and participating in the presentation of papers and the ensuing discussions thereof, were the leading figures in tuberculosis research in Europe, Great Britain, and America. Dr. Arnold Rich acted as chairman.

This symposium was especially noteworthy for the reason that the subjects of the chemo- and antibiotic treatment of tuberculosis and the results of such therapy were rigidly excluded. The symposium therefore centered on the broad and fundamental problem of host-parasite relationship. The 22 papers which make up this volume are on such subjects as the chemical structure of the *Mycobacterium tuberculosis*, the biologic activity of the various components of the bacillus, the role of the lipoid, carbohydrate, and protein fractions in the stimulation of hypersensitivity and resistance by the host, the cellular, serologic, and humoral aspects of resistance or immunity, and so forth.

While there is nothing in this volume dealing directly with ophthalmology, nevertheless it is an invaluable addition to the library of anyone really interested in the basic problems of ocular tuberculosis—in such problems as the influence of hypersensitivity on the lesion, the mechanisms of desensitization, the factors which influence phagocytosis of the bacilli and encapsulation of the lesions, the deleterious influence of the adrenal corticosteroids on the character of the tuberculous lesion, the nature of drug resistance, the means whereby the bacilli adapt themselves to an adverse environment, and so forth. These subjects are all just as pertinent to the subject of ocular tuberculosis as they are to the systemic lesions and a knowledge of them is necessary if one is to explore intelligently the subject of ocular tuberculosis. In this volume the interested student and the laboratory worker will find a remarkably up-to-date résumé of these subjects, and a veritable gold mine of stimulating information.

The book is not overly technical, is readily readable, is well edited and indexed. The Ciba Foundation is to be congratulated on this symposium. These proceedings will be a valuable guide and reference work to other investigators in this field.

Alan C. Woods.

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THE ARTERIAL INTRACRANIAL ANEURYSMS. By Paul Bonnet. Paris, Masson et Cie, 1955. 118 pages, 48 illustrations, two color plates, bibliography. Price: 1,500 francs.

This delightful monograph, beautifully printed and illustrated, discusses in an austere and tight style a subject of interest and great importance to ophthalmologists. "The ophthalmologists do not yet know enough," says the author, who is professor of clinical ophthalmology of the Faculty of Medicine of Lyon, "in spite of the great number of published works, about the interest this question presents to their specialty. They do not yet know what role they are called upon to fill."

Professor Bonnet proceeds clearly to enlighten us on this subject, and considers the history, general aspects, etiology, pathogenesis, anatomico-clinical forms (internal carotid, circle of Willis, basilar trunk, and vertebral arteries), diagnosis, prognosis, and treatment (neurosurgical).

Those who read French are urged to obtain a copy and study it carefully. It will be a happy experience.

Derrick Vail.

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CURRENT THERAPY: 1956. Edited by Howard F. Conn, M.D. Philadelphia, W. B. Saunders Company, 1956. 607 pages, index. Price: $11.00.

When the 1955 edition of this book was reviewed in these pages, it was noted that, among the several hundred contributors, there was not to be found the name of a single ophthalmologist. In the current edition, there has been discovered the name of Dr. Max. Fine, who has contributed a short discussion of the treatment of optic neuritis.

Aside from this, ocular conditions are largely ignored or mentioned casually by internists, allergists, or neurologists. For this reason, the volume has little value for the practicing ophthalmologist.

William A. Mann.

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DOCUMENTA OPHTHALMOLOGICA: VOLUME IX. The Hague, Uitgeverij Dr. W. Junk, 1955. 208 pages, 56 figures, 22 tables, references. Price: Not listed.

The first segment of Volume IX of Documenta Ophthalmologica contains two reports, one by Buerki written in German, on the histopathology of the primary tumors of the meibomian gland, and the other a study of anomalous retinal correspondence by Serge Kretzschmar, in French.

Buerki's article of 45 pages with 16 figures and 51 references starts with a summary of the literature which reveals 95 reported cases. All the essential data are tabulated. Buerki adds his own observation of a further case which proved to be a cylindroma. Many of the tumors of the tarsal glands which were described as carcinoma were really benign cylindromas. Histologic study of tumors, which for the most part occur in older subjects, shows that they may be classified as benign or relatively benign fibroepitheliomas and carcinomas. The neoplasms of the tarsal glands, in contrast to the carcinomas of the skin, usually occur in the upper lid and in the beginning are often mistaken for chalazion, but later their appearance is so characteristic that the diagnosis is possible without biopsy.

Serge Kretzschmar provides an extensive (163 pages) analysis of the problem of anomalous retinal correspondence which is illustrated with 56 figures and 22 tables of data and documented by the citation of 282 references. He reviews briefly the physiology of binocular vision and particularly the development of our knowledge of anomalous retinal correspondence. He emphasizes those questions which have been inadequately answered and describes the classic methods of investigation as well as those devised by himself. Among the latter are a method of haploscopy in which polarized light is exploited, color haploscopy with the Goldmann perimeter, and the simultaneous use of several pairs of haploscopic images. He studied many details of the phenomenon of anomalous correspondence and records the data in detail. In his conclusion he gives an integrated account of the processes of anomalous co-ordination of visual axes in terms of anatomic and physiologic units.

F. H. Haessler.

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A MODERN PILGRIM'S PROGRESS FOR DIABETICS. By Garfield G. Duncan, M.D. Philadelphia, W. B. Saunders Co., 1956. 222 pages. Price: $2.50.

This book presents in story form and tables everything that the diabetics and their relatives need to know about the disease to cooperate understandingly. The layman is informed in his own language of the variety of incidents that may beset him including the different eye complications. This volume is a guide, philosophic and when possible comforting, to the ups and downs of diabetes; as Bunyan's classic is on the vicissitudes of life.

James E. Lebensohn.

# ABSTRACT DEPARTMENT

EDITED BY DR. F. HERBERT HAESSLER

Abstracts are classified under the divisions listed below. It must be remembered that any given paper may belong to several divisions of ophthalmology, although here it is mentioned only in one. Not all of the headings will necessarily be found in any one issue of the Journal.

## CLASSIFICATION

1. Anatomy, embryology, and comparative ophthalmology
2. General pathology, bacteriology, immunology
3. Vegetative physiology, biochemistry, pharmacology, toxicology
4. Physiologic optics, refraction, color vision
5. Diagnosis and therapy
6. Ocular motility
7. Conjunctiva, cornea, sclera
8. Uvea, sympathetic disease, aqueous
9. Glaucoma and ocular tension
10. Crystalline lens
11. Retina and vitreous
12. Optic nerve and chiasm
13. Neuro-ophthalmology
14. Eyeball, orbit, sinuses
15. Eyelids, lacrimal apparatus
16. Tumors
17. Injuries
18. Systemic disease and parasites
19. Congenital deformities, heredity
20. Hygiene, sociology, education, and history

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## 1
## ANATOMY, EMBRYOLOGY, AND COMPARATIVE OPHTHALMOLOGY

Boeke, W., and Lindner, E. **Electron microscopic studies of zonular fibers.** Arch. f. Ophth. **157**:101-106, 1955.

The authors studied the zonular fibers of guinea pigs and calves and found them composed of smaller fibrils in a lattice-like arrangement. Sometimes cross-striation of the fibrils became noticeable. The zonular fibers seemed to form a kind of membrane on the surface which is turned away from the lens capsule. (4 figures, 17 references) Ernest Schmerl.

Cowan, Alfred. **Observations on ocular pigment and pigmentation.** A.M.A. Arch. Ophth. **55**:161-173, Feb., 1956.

This learned scientific essay discusses the great amount of present knowledge regarding natural pigment. Much investigation needs still to be done and Cowan says it should be done by ophthalmologists. (51 references) G. S. Tyner.

Siebeck, R., and Krueger, P. **The histologic structure of the extrinsic ocular muscles as an expression of their function.** Arch. f. Ophth. **156**:637-652, 1955.

Skeletal muscles do work in a mechanical or physical sense or resist forces by tonic contraction; the ocular muscles merely bring about rotation of a sphere about its center of mass and are opposed by no force other than mutual antagonism. It is probable, however, that the two kinds of activity of the eye muscles, namely binocular rotations and movements of fusion, are comparable to the two functions of skeletal muscles.

In this study the authors demonstrate two groups of fiber bundles with recognizably different structures in the rectus and oblique muscles of several animals. They recognize bundles with "Felderstructur" (literally checkered) and fibrillar structure, and these two kinds of fibers may well serve to bring about the two different muscular functions. (4 figures, 76 references) F. H. Haessler.

Thiel, H. L. **The topographic and histologic situation of the ora serrata.** Arch. f. Ophth. **156**:590-629, 1955.

In this extensive and painstaking study a large number of measurements were recorded. In the macroscopic portion of the study an ideal framework was constructed into which the ora serrata could be projected. Transillumination of enucleated eyeballs made it possible to mark

the situation of the ora or the sclera and to relate it to other landmarks. In the microscopic part of the project the most anterior segments of the retina were studied and the author succeeded in introducing a certain order to the problem of the cyst-like spaces found there. Some of them are physiologic and others an expression of cystoid degeneration. A glance at the tables of data, the diagrams and the figures tells more of this admirable study than is possible in an abstract. (17 figures, 7 tables, 54 references)

F. H. Haessler.

Wybar, Kenneth C. **Anastomoses between the retinal and ciliary arterial circulations.** Brit. J. Ophth. **40**:65-81, Feb., 1956.

By injecting Neoprene into the ophthalmic artery of 17 normal human eyes which had been removed at autopsy, the author was able to obtain cast studies of the ocular circulation. The latter were isolated by digesting the ocular tissues in pepsin and trypsin. Two types of uveoretinal arterial anastomoses were found. One type presented anastomoses between the central retinal artery and the arterial plexus of the pia mater surrounding the anterior portion of the optic nerve. The other furnished evidence of anastomoses between the central retinal artery and the intrascleral circle of Zinn. The author suggests the prompt administration of oxygen when there is an inadequate supply of retinal circulation. This may permit the ganglion cells to survive until re-establishment of circulation by a collateral channel. (10 figures, 34 references) Lawrence L. Garner.

## 2

## GENERAL PATHOLOGY, BACTERIOLOGY, IMMUNOLOGY

Busse-Grawitz, Ernst Günther. **Experimental keratitis produced by instillations of silver nitrate into the conjunctiva.** Arch. f. Ophth. **157**:207-210, 1955.

After instillation of weak solutions of silver nitrate no mature leucocytes were found in the cornea. However, immature leucocyte-like cells and incompletely transformed fibrous areas were seen in deeper corneal layers. The author feels that these tissue changes represent precursors of inflammatory leucocytic elements formed in situ and not by invasion from the blood. (2 tables, 2 references)

Ernst Schmerl.

Fazakas, Alexander. **Mycotic infections of the eye and their treatment.** Klin. Monatsbl. f. Augenh. **127**:701-721, 1955.

This is a summary of the author's long experience with ocular mycology. He found 10 cases of occlusion of a lacrimal canaliculus by a fungus (mostly actinomyces). Only once was the upper canaliculus affected. Four cases of mycotic blepharitis were observed, and five infections of the lashes (mostly trychophyton) and the brow. Of 20 mycotic inflammations of the cornea 11 were superficial, seven deep and two combined. Aspergillus (fumigatus and flavus) and actinomyces were the most frequent organisms. A secondary mycotic infection of the cornea occurred in trachoma, phlyctenular pannus, serpiginous ulcer, dendritic keratitis and inclusion blennorrhea.

Frederick C. Blodi.

Grigorieva, V. **Experimental histologic study of the process of healing of wounds of the cornea.** Vestnik oftal. **34**:11-17, March-April, 1955.

Histologic observations of injured rabbit corneas were made from 30 minutes to two months after the injury. Two stages are observed in the process of the healing of the corneal wound, the initial, or degenerative, and the second, or regenerative stage. The aqueous together with the protein fractions of the blood and

necrotic parts of the injured cornea form a fibrinous plug, which covers the wound in the first hours after the injury. The inflammatory reaction appears as a defensive adjustment in response to the changed conditions of the metabolism of the traumatized corneal tissue. The migrating polymorphonuclear leucocytes play an important role in the proteolytic process in the initial stage of healing. The polyblastic elements serve an important function in the second stage of the healing, the proliferative-regenerative stage. The epithelial layer of the cornea has a highly regenerative ability. In the first few minutes after the injury, the epithelial cells move towards the injured area; at first they multiply by direct and later on by indirect division. The epithelium does not have the proper differentiation until Bowman's membrane forms anew. Bowman's membrane appears on about the fifteenth day of the healing and is fully formed by the twentieth day. Its formation is associated with the mature connective tissue layer of the corneal scars. The nontransparent scar tissue at the site of the injury is in close contact with the regenerated connective tissue, which develops as a result of the proliferative-regenerative activity of the less differentiated fibroblasts of the cornea. They form rougher collagen fibers with a disorganized location. The posterior basal membrane forms not only from the active, newly formed endothelium, but also as a result of establishing a relationship between the endothelium and the regenerated connective tissue. (1 table)

Olga Sitchevska.

Hellström, Bo E. **Experimental approach to the pathogenesis of retrolental fibroplasia.** A.M.A. Arch. Ophth. **55**:211-220, Feb., 1956.

In view of the as yet undiscovered manner by which oxygen administration is related to retrolental fibroplasia in premature infants, the author decided to use the electroretinogram in experimenting with kittens.

Hellström is not certain whether oxygen injury in the retina of kittens is primarily ischemic or cytotoxic but says that retinal damage reflected in an abnormal ERG occurs while the animal is still in oxygen and that the succeeding vasoproliferating phase is electroretinographically accompanied by a restoration to normal. It would seem that the vasoproliferating stage, commonly described as the first clinical stage of the disease, actually is a secondary phase. Why this reparative stage is so excessive as to cause retrolental fibroplasia is unexplained.

Exposure to 85 to 95 percent oxygen for 10 to 13 hours did not cause any significant changes in the ERG in 2-weeks-old kittens. Kittens raised from birth up to 21 to 28 days of age in 70 percent oxygen frequently showed an abnormal, negative ERG. (8 figures, 25 references)

G. S. Tyner.

Ogielska, E., Skurski, A., and Ogielski, L. **Ocular bacterial flora in iritis.** Postepy Okulistyki **1**:85-98, 1954.

The authors review the ideas related to the pathogenesis of iritis. Focal infection and local allergic reaction are mentioned. The relation of bacterial flora of the eye to iritis was investigated. In 60 cases of iritis smears and cultures of the aqueous were examined and the conjunctival flora was examined at the same time. In only three cases were organisms found in the aqueous; staphylococcus aureus or albus but no streptococci were found. There is a suggestion that bacterial flora of the conjunctiva may have some relation to iritis; in many cases strains of staphylococcus aureus, which produced coagulase and phosphatase, were found. Strains of staphylococcus albus with similar ability were also found. In control subjects this

enzymatic action of staphylococcus was weaker or absent. (4 tables, 35 references) Sylvan Brandon.

Ormsby, H. L., Fowle, A. M. C., and Cockeram, A. **Relationship of epidemic keratoconjunctivitis to the adenoidal-pharyngeal-conjunctival (APC) virus syndrome.** Canad. M.A.J. **73**:710-713, Nov. 1, 1955.

Epidemic keratoconjunctivitis was reported in Ontario in 1951 and was again seen in the Toronto area in the winter of 1954-55. From seven of the patients the virus was isolated and the disease reproduced in a human volunteer. Some of the strains of the virus were shown to belong immunologically to the type 3 APC group of viruses, such as was present in the Washington, D.C. epidemics. (2 tables, 14 references) Irwin E. Gaynon.

Sachsenweger, R. **Clinical and experimental examinations of ocular infections with saprophytic fungi.** Klin. Monatsbl. f. Augenh. **127**:721-730, 1955.

Three children were given subconjunctival injections of 3-percent sodium chloride solution for a degnerative or traumatic lesion in the macula. Each of them developed a violent, hyperplastic conjunctivitis after the third injection which subsided after three months. Microbiologic examination of the vials revealed that they contained three kinds of fungi. In a biopsy the conjunctiva presented the picture of a granulomatous infection in which fungi could be found with the appropriate staining methods. (4 figures, 24 references) Frederick C. Blodi.

Suie, T., Havener, W. H., and Sroupe, S. A. **In vitro sensitivity of Micrococcus pyogenes to the commonly used antibiotics. Application of these tests to the treatment of bacterial ocular infections.** Brit. J. Ophth. **40**:100-103, Feb., 1956.

The authors report their results of antibiotic sensitivity tests in 115 isolations of Micrococcus pyogenes (Staphylococcus). The disk method was employed and all cultures were made under strict, aseptic technique. The drugs tested included aureomycin, bacitracin, chloramphenicol, dihydrostreptomycin, penicillin, polymyxin B., terramycin, neomycin, tetracycline, erythromycin and furacin. Of the drugs tested, bacitracin showed the greatest activity against the organism and polymyxin showed the least. Furacin inhibited the growth of all the organisms tested. Organisms which were coagulase positive did not differ significantly in their antibiotic response. The authors recommend that in serious ocular infections one should not hesitate to use bacterial culture and sensitivity tests with combined antibiotic therapy. (1 table, 3 references) Lawrence L. Garner.

## 3

### VEGETATIVE PHYSIOLOGY BIOCHEMISTRY, PHARMACOLOGY, TOXICOLOGY

Abraham, R. K., and Burnett, H. H. **Tetracycline and chloramphenicol studies on rabbit and human eyes.** A.M.A. Arch. Ophth. **54**:641-659, Nov., 1955.

The oral administration of tetracycline resulted in effective levels in the aqueous humor if given in large amounts. Although inferior to chloramphenicol in its penetrating abilities, it may be the drug of choice in ocular infections because it does not possess the potential bone marrow-depressing action of chloramphenicol.

If tetracycline is used, massive doses are required. Suggested oral dosages are 3.0 grams initially, followed by 1.0 gram every 4 hours. The entire schedule, including the 3 gram initial dose should be repeated every 48 hours. Much smaller doses of chloramphenicol are required to give effective plasma levels. The abstractor is not aware that the hazards of bone

marrow depression with chloramphenicol have been substantiated to the point where a drug giving inferior results should be substituted when chloramphenicol is indicated. (3 figures, 12 tables, 34 references) G. S. Tyner.

Boros, B., and Takats, I. **Mediator substances showing a reversal of normal action upon iris muscle.** Arch. f. Ophth. 157:107-115, 1955.

The authors discuss the problem and the literature. In experiments in vitro with cats' sphincters they found a reversal of action after precipitation of the calcium of the tissues and the administration of the following mediator substances. Adrenaline and cocaine contracted the usually relaxing sphincter. Histamine, diluted 1 : 100,000, also produced a contraction while the action of atropine did not seem to be affected. Methods and control experiments are discussed in detail. (6 figures, 16 references) Ernst Schmerl.

Boruchoff, S. A., and Woodin, A. M. **Viscosity and composition of solutions derived from rabbit vitreous humour.** Brit. J. Ophth. **40**:113-118, Feb., 1956.

The technical details of this analytical study are described. The vitreous of the rabbit contains less hyaluronic acid but more residual protein than that of the ox. Injections of hyaluronidase liquefy vitreous gel through disaggregation of the hyaluronic acid. (3 tables, 10 references) Lawrence L. Garner.

Brauns, and Heinsius, E. **The use of Leukomycin eye drops.** Klin. Monatsbl. f. Augenh. **127**:747-750, 1955.

Leukomycin is a 0.5-percent aqueous solution of chloramphenicol. It remains stable for three months. It proved to be effective in a variety of external infections. An allergic reaction (dermatitis) occurred in only one out of 161 patients. (13 references) Frederick C. Blodi.

Desvignes, Pierre. **Eye manifestations of deficiencies of fat soluble vitamins (A, D, and E).** Arq. brasil. de oftal. 17:173-221, 1954.

The two well-known signs of vitamin A deficiency are xerosis of the cornea and conjunctiva and night blindness. The former may progress to keratomalacia, the terminal phase of xerophthalmia. Epithelial dryness of the conjunctiva is the first sign of xerophthalmia, and resembles a simple conjunctivitis or blepharitis. Gradual loss of lustre is followed by the appearance of the classical Bitot spot, produced by keratinization of the mucosa. Administration of the vitamin at this stage arrests the progression and may cause regression. Should the lesion progress, the mucosa becomes altered with ulcerations, contractions and symblepharon formation. There is an associated decrease in lacrimal secretion.

The cornea is involved simultaneously, with loss of epithelial transparency, alteration of the precorneal lacrimal film and the appearance of punctate corneal opacities. A painless corneal ulceration follows with possible corneal perforation and endophthalmitis. The evolution toward keratomalacia is usually rapid and irreversible. It is emphasized that the cornea does not contain vitamin A, and that some substance derived from it is the active element in preventing xerophthalmia.

Hemeralopia, or night blindness, is the second sign of deficiency and is a subjective complaint. The patient has normal vision in daylight, but complains of inability to see in reduced illumination. Examination is negative with the exception of poor dark adaptation, which can be determined with special apparatus. Determinations of the vitamin A content of the blood have been correlated with adaptation studies and the results seem to correspond closely prior to therapy, with less correlation after administration of the

vitamin, since the blood level may increase prior to its therapeutic effect. Visual purple, or rhodopsin, is the photosensitive pigment which is broken down when the retina is exposed to light. A complex metabolic process results in its regeneration, with vitamin A playing a major role in the cycle.

In addition to vitamin A, it seems that riboflavin has some action in prevention of night blindness, with assistance from vitamin E which favors storage of vitamin A in the liver.

Vitamin A deficiency has been mentioned as a possible cause of other ocular conditions, among which are defects of visual fields and of color perception, accommodative asthenopia, conjunctival pigmentation and fundus changes (deposition of white spots, edema).

Clinically, deficiencies are observed most frequently during famine, war, and in infants whose milk supply is deficient in the vitamin. It is also observed in liver disease, gastric achylia, and other gastrointestinal disorders.

Lack of vitamin D in itself apparently has no effect upon the eye. The tetanic cataract is associated with reduction of blood calcium and phosphorus which results from deficiency of the vitamin. However, administration of the vitamin seems to have no effect upon the lens opacity. Deficiency of the vitamin and also of calcium has been mentioned as a possible cause of myopia, but this theory has few supporters. On the other hand, hypervitaminosis D is known to increase the blood level of calcium and may produce corneal keratinization.

The author mentions the possible role of vitamin E deficiency in the etiology of retrolental fibroplasia, keratoconus and retinal degeneration. The interaction of all the fat-soluble vitamins is considered as indispensable for the maintenance of good health. (4 figures, 130 references)

James W. Brennan.

François, J., Rabaey, M., and Neetens, A. **Perfusion studies on the outflow of aqueous humor in human eyes.** A.M.A. Arch. Ophth. **55**:193-204, Feb., 1956.

After discussing past work on aqueous humor outflow, the authors report the findings of their research. They conclude that the rate of outflow obtained by perfusion of human eyes is the same as that obtained by clinical tonography ($C = 0.25$ cu. mm. and $R = 4$). The outflow of the perfusion fluid depends only on anatomic conditions.

The rate of outflow is directly proportioned to the depth of the anterior chamber, and the factor of the chamber depth should be considered as much in the clinical tonography as in the experimental perfusion value. In the case of wide-angle glaucoma, the perfusion study, as well as the tonographic measurement, shows an increased resistance to outflow ($C = 0.05$ cu. mm. and $R = 20$). (15 figures, 1 table, 19 references)

G. S. Tyner.

Friedenwald, J. S., and Becker, B. **Aqueous humor dynamics.** A.M.A. Arch. Ophth. **54**:799-815, Dec., 1955.

This article is a review of the recently published work of Kinsey and Palm on anterior and posterior chamber aqueous function. The authors conclude that accepting the differential equations of Kinsey and Palm as valid, one can construct a more general mathematical theory of aqueous humor dynamics than has heretofore been available. The application of this theory makes possible the resolution of a number of apparent contradictions in the literature on aqueous humor dynamics. (6 figures, 3 tables, 11 references)

G. S. Tyner.

Garcia Miranda, Ramon. **Internal ophthalmoplegia from lead intoxication.** Arch. Soc. oftal. hispano-am. **15**:1070-1074, Sept., 1955.

A painter, 28 years old, developed symptoms of encephalopathy, associated with loss of reflexes, a paralytic mydriasis of the right eye, and a positive response to pilocarpine. He subsequently developed severe abdominal disturbances attributed to lead intoxication. He was cured, with recovery of the internal ophthalmoplegia. The literature on internal ophthalmoplegia is reviewed.

Ray K. Daily.

Gemolotto, Guglielmo. **Electrophoretic studies of the blood serum protein in some eye diseases. IV. In idiopathic retinal detachment.** Arch. di ottal. **59**:511-516, Nov.-Dec., 1955.

No alteration of the serum proteins was found in retinal detachment. (1 table, 15 references) John J. Stern.

Glees, M., and Josten, K. **The quantitative determination of hyaluronic acid in the vitreous of cattle and calves.** Arch. f. Ophth. **156**:653-655, 1956.

The method is described with which it was shown that the vitreous of adult cattle contains twice as much hyaluronic acid as that of calves. This datum adequately explains the change in rheologic reaction which occurs with age. (1 table, 8 references) F. H. Haessler.

Gloster, J., and Perkins, E. S. **Carbonic anhydrase in the lens and in the ciliary body and iris of albino rabbits.** J. Physiol. **130**:665-673, Dec. 29, 1955.

The carbonic anhydrase present in extracts prepared from the lens, iris and ciliary body of albino rabbits was measured manometrically and by an indicator. The author also devised means by which the blood content of extracts from the iris and ciliary body could be estimated. Extracts from the uveal tissue were found to contain more carbonic anhydrase than that which was contributed by the blood in the iris. Extracts from the lens exhibited high carbonic anhydrase activity. In equal weights of tissue there was 6 to 13 times as much carbonic anhydrase as in uveal tissue. (3 figures, 3 tables, 18 references)

F. H. Haessler.

Green, H., Kroman, H. S., and Leopold, I. H. **Corticosteroids in the aqueous humor of the rabbit.** A.M.A. Arch. Ophth. **54**:853-857, Dec., 1955.

Paper partition chromatography was utilized in determining the content of corticosteroids in rabbit aqueous. The results are of experimental but not clinical interest. (3 figures, 5 references)

G. S. Tyner.

Hans, W., Hockwin, O. and Kleifeld, O. **Polarographic determination of oxygen consumption of the lens.** Arch. f. Ophth. **157**:72-84, 1955.

Polarography, a special method of physical chemistry, was used in this study to determine most accurately the oxygen consumption of rabbits' and pigs' lenses. The authors found that in rabbits' lenses the average consumption of oxygen was 7.8 $mm.^3$/gr./hour and in pigs' lenses 13.6 $mm.^3$/gr./hour. These values compare favorably with the smallest values found by other authors with the help of Warburg's manometric methods. (3 figures, 5 tables, 32 references)

Ernst Schmerl.

Hockwin, O., Kleifeld, O., and Hans, W. **Polarographic determination of the glutathion content of the lens.** Arch. f. Ophth. **157**:140-148, 1955.

The authors used the same method as in the determination of the oxygen consumption of the lens (Arch. f. Ophth. 157: 72-84, 1955) and found average values of $195 \pm 6.9$ mg. glutathion per 100 gram hog lens and $151.3 \pm 8.9$ mg. glutathion per 100 gram beef lens. (3 figures, 7 tables, 35 references) Ernst Schmerl.

Keeney, A. H., and Mody, M. V. **Adrenosem (carbazochrome) in primary glaucoma and diabetic retinopathy.** A.M.A. Arch. Ophth. **54**:665-669, Nov., 1955.

Adrenosem (carbazochrome) did not exert any significant effect on glaucoma or diabetic retinopathy. (8 references)

G. S. Tyner.

Kleifeld, O., Mueller, H. K., Hockwin, O., and Arens, P. **The significance of capsule and epithelium in the phosphate absorption in the lens.** Arch. f. Ophth. **156**:443-452, 1955.

Experiments in which labeled phosphates ($P^{32}$) were used, showed that the active intake of phosphate by the intact lens is a cooperative function of the capsule and fiber of the len and, when it takes place through the anterior surface, of the epithelium a well. (3 figures, 8 tables, 13 references) F. H. Haessler.

Kleifeld, O., Mueller, H. K., Dardenne, U., Fuchs, R., Hockwin, O., and Arens, P. **The introduction of $P^{32}$ into the electrophoretically separable phosphate fraction in the lens.** Arch. f. Ophth. **156**:453-459, 1955.

Frozen sections showed that radioactive phosphate penetrates the lens to a depth of about 1 mm. when the lens has been immersed for two hours in a nutrient solution which contains $P^{32}$. In neither the rabbit's nor the calf's lens was there a difference in distribution to the three electrophoretically separable fractions (ATP which is adenosine triphosphate, restphosphate and inorganic phosphate) of that $P^{32}$ which entered to lens through the anterior surface of the lens and that which entered through the posterior surface. The process was considerably inhibited by cyanide on both anterior and posterior surfaces of the intact lens, but not after the capsule and epithelium had been removed. The lens without capsule is still as capable of introducing $P^{32}$ into ATP as the intact lens. Unlike potassium cyanide, monoiodidacetic acid and sodium fluoride alter the distribution of $P^{32}$ to the three phosphate fractions in the lens which has been denuded. (6 tables, 11 references)

F. H. Haessler.

Mueller, H. K., Kleifeld, O., Fuchs, R., Dardenne, U., Hockwin, O., and Arens, P. **The relation of the electrophoretically separable phosphate fractions (labeled with $P^{32}$) of the lens to age and to poisoning with naphthalin, dinitrophenol and alloxan.** Arch. f. Ophth. **156**:460-466, 1955.

The introduction of $P^{32}$ into the ATP fraction is no different in the ageing lens than in the young, but in the aged lens the restphosphate takes more $P^{32}$. This finding suggests that there is qualitative alteration in the carbohydrate metabolism as well as a quantitative reduction.

Clear and opaque lenses of rabbits with alloxan-induced diabetes revealed a decreased introduction of $P^{32}$ into the ATP fraction and an increased introduction into the restphosphate fraction.

Lenses of rabbits poisoned with naphthalin, whether clear or opaque, showed a slight decrease of 7 min hydrolysable phosphate but no change in the distribution of $P^{32}$ to the three electrophoretically separable phosphate fraction. Similarly, there was no modification of this reaction in the dinitrophenol cataracts of young cocks. (7 tables, 15 references)

F. H. Haessler.

Kleifeld, O., Hockwin, O., and Arens, P. **Metabolic changes in the lens during accommodation.** Arch. f. Ophth. **156**:467-479, 1955.

It is probable that metatolic changes take place in the lens during accommodation and these are probably ascribable to changes in the lens fibers. The lens

fibers probably take an active part in the process of intracapsular accommodation. Electric impulses bring about changes of refraction in lenses in vitro and in the living eye. In such lenses the authors found a reduction in the vitamin C and lactic acid content and an increase of the oxygen consumption. In pigs' lenses which have been stimulated electrically in vitro and in accommodated lenses of living pigeons they found a reduction in sugar content. In the pig's eye the content of 7 min hydrolisable phosphate was decreased and in similarly treated eyes of pigs and calves the reduced glutathion content was similarly reduced. Massage of the pig's lens was followed by an increased glutathion content and agitation increased oxygen consumption. The other substances were unchanged in these lenses. (7 tables, 15 references)

F. H. Haessler.

Kornbluth, W., and Linnér, E. **Experimental tonography in rabbits,** A.M.A. Arch. Ophth. **54**:717-724, Nov., 1955.

This study was designed to evaluate a vascular factor which might influence aqueous flow as determined by tonography. Unilateral carotid ligation caused a decrease in rate of aqueous flow on the ligated side, suggesting a hemostatic mechanism for the maintenance of constant intraocular pressure during a changing rate of aqueous flow. (8 tables, 15 references)

G. S. Tyner.

Krwawicz, T., and Borkowski, T. **Cholinesterase in the aqueous of glaucomatous patients.** Postepy Okulistyki 1: 124-131, 1954.

Using Warburg's instrument, the authors measured the presence and the activity of cholinesterase in the aqueous by a manometric method. Vitamin B and the digitalis derivative "cedilamid" were found to decrease activity of cholinesterase in vitro. When used on patients, vitamin B was found to be totally ineffective. Cedilamid was found to decrease the amount of cholinesterase but it did not influence the tension of glaucomatous eyes. (2 tables, 14 references)

Sylvan Brandon.

Krwawicz, T., Kozuchowska, S., and Vorbrodt, A. **Histochemical examination of damaged cornea.** Postepy Okulistyki 1:131-143, 1954.

Histochemical changes of the injured cornea were experimentally examined. The authors incised the cornea of nine albino rabbits. The second eye served as the control. Corneas were taken for examination after 24, 48, and 72 hours and also after 5, 7, 9 and 14 days. Injured human corneas were also used for investigation. The behavior of vitamin C, sulfhydryl groups, ribonucleic acid, deoxyribonucleic acid and phosphatase was observed. The process of healing of the corneal wound is described, with particular emphasis on the behavior of the abovementioned chemical groups. The authors found that ascorbic acid does not take any active part in the healing process but the substances containing a sulfhydryl group considerably increased in the multiplying epithelium and in the early stages of healing stroma. The presence of vitamin C shows that the epithelial cells are functioning normally and its disappearance confirms the presence of a pathologic condition. Damage to Descemet's membrane affects reaction of the cornea with vitamin C. The authors associate the increase of reaction for phosphatase with the increased vascularization. Considerable increase of the ribonucleic acid in the cytoplasm of the infiltrate within the wound and of the regenerating epithelium shows that it plays an important role in the healing of the wound. The distribution of the deoxy-

ribonucleic acid is little changed and its role in the healing process is doubtful. (11 figures, 10 references)

Sylvan Brandon.

Leinfelder, P. J., and Riley, E. F. **Further studies of effects of X-radiation on partially shielded lens of rabbit.** A.M.A. Arch. Ophth. **55**:84-86, Jan., 1956.

When two or three quadrants of the lens are shielded from the injury of X-radiation, the protected portions may somehow prevent the progression of a complete radiation cataract. Only a partial opacity in the exposed area was observed when one quadrant was exposed to an amount of X-radiation (3000 to 5000 r) that produced a complete cataract when all four quadrants were exposed. In fact, doses of X-radiation as high a 12,000 r produced only partial cataract in the exposed quadrants of the rabbit lens when two or three of the lens quadrants were shielded from the radiation. (3 figures, 2 references) G. S. Tyner.

Leopold, I. H., Sawyer, J. L., and Green, H. **Intraocular penetration of locally applied steroids.** A.M.A. Arch. Ophth. **54**:916-921, Dec., 1955.

This investigation was initiated to determine whether any correlation exists between the penetration of the corticosteroids into the anterior chamber of rabbit eyes and their chemical structure, and the therapeutic efficacy of the local use of these drugs in clinical ophthalmology. It is evident from the results that the rate of penetration of the particular corticosteroid into the aqueous humor of the anterior chamber is dependent upon the specific experimental condition and that no definite correlation can be established between rate of penetration and chemical structure of the steroids. (3 figures, 3 tables, 8 references).

G. S. Tyner.

Lepri, G., and Capalbi, S. **Comparative studies of the efficacy of cortisone and prednisone in experimental anaphylactic uveitis of the rabbit.** Arch. di ottal. **59**: 497-510, Nov.-Dec., 1955.

Cortisone and prednisone were equally effective in inhibiting the manifestations of experimental anaphylactic uveitis. (6 figures, 37 references) John J. Stern.

Linner, E., and Prijot, E. **Cervical sympathetic ganglionectomy and aqueous flow.** A.M.A. Arch. Ophth. **54**:831-833, Dec., 1955.

The effect of extirpation of the superior cervical sympathetic ganglion on the aqueous humor dynamics was studied in rabbits. A marked decrease of the intraocular pressure and of the rate of aqueous flow was found one day after the operation, followed by a restoration to normal values a few days later. No significant change was found in the facility of outflow or in the episcleral venous pressure. (1 table, 12 references)

G. S. Tyner.

Meesmann, A. **Action of sympathicolytics upon the accommodation.** Arch. f. Ophth. **157**:188-200, 1955.

On the basis of former studies, the author had reached the conclusion that the ciliary muscle has a parasympathetic as well as sympathetic innervation. In the present investigation he used enucleated cats' eyes and a few normal human beings, to study the action of gynergen, dihydro-ergotamine and dibenamine. If these pharmaca were added in advance to solutions of prostigmine in which the cats' eyes were bathed, photographic registration showed a pronounced increase in the activity of physostigmine. The author feels that this increase is not based on a sympathicolytic action of the drugs but demonstrates for the ciliary body of the cat true parasympathicomimetic action. In man gynergen relaxed the accom-

modation by 0.75 D, probably as a result of sympathicolysis. The behavior of the human eye in therefore completely different from that of the cat's eye with respect to the autonomic drugs studied in this investigation. (2 figures, 16 references) Ernst Schmerl.

Michaelson, I. C., and Schreiber, H. **Influence of low-voltage X-radiation on regression of established corneal vessels.** A.M.A. Arch. Ophth. **55**:48-51, Jan., 1956.

By previous experiments, it has been known that low-voltage X-radiation can inhibit, but not prevent, new vessel growth into the cornea. The present research is designed to throw light on the regression effect of radiation on vascularization that has been experimentally produced. The authors conclude that total doses of low-voltage X-radiation varying from 700 to 2400 r have no regressive effect on established corneal vessels. (2 figures, 4 tables, 3 references) G. S. Tyner.

Moore, C. H., Herrick, J. F., and Martens, T. G. **Some effects of ultrasonic energy on the rabbit eye.** A.M.A. Arch. Ophth. **54**:922-930., Dec., 1955.

Observations were made on intact and enucleated eyes as to the effects of ultrasonic energy. The minimal damage-producing dose is apparently less than 10 watts for 2¼ minutes. Increase in vitreous temperature and posterior polar cataracts were significant sequellae. (5 figures, 11 references) G. S. Tyner.

Muenich, W., and Oswald, A. **Paper electrophoresis of several proteins of calves eyes.** Arch. f. Ophth. **156**:547-550, 1955.

Water-soluble proteins were extracted from cornea, lens, iris and retina. A typical pherogram was found for each tissue. Only the proteins of the iris corresponded to those of the blood. (4 figures, 1 table, 12 references) F. H. Haessler.

Páez Allende, F. **Clinical experiences with Datura stramonium.** Arch. oftal. Buenos Aires **30**:340-342, Sept., 1955.

If used as a 5-percent leaf powder infusion, Datura stramonium (jimson weed) produces good mydriasis and cycloplegia which appear within 20 to 40 minutes after the instillation of a few drops into the conjunctival sac and last for as long as four days. The drug is nonirritant and atoxic when administered in the dosages required in ophthalmic practice. Its parasympathicolytic effect is due to the active principles, which are mainly hyoscine, hyosciamine and atropine. (1 figure, 3 references) A. Urrets-Zavalía, Jr.

Papst, Wolfgang. **The electroretinogram and the electrocorticogram of the rabbit in hypoglycemia and in anoxia.** Arch. f. Ophth. **157**:122-139, 1955.

The high aerobic and anaerobic glycolysis of the mammalian retina has been known for many years. Several authors had found that with elimination of the anaerobic glycolysis in the living animal by injections of mono-iodine-acetic acid the b-wave of the electroretinogram was also abolished. Histologically selective damage to the retinal receptors and the outer nuclear layer had been found. The present investigation started with the study of the ERG and ECG during hypoglycemia. The author describes his method most carefully and gives the following summary of his findings: The amplitude of the b-wave of the ERG diminishes in hypoglycemia, and especially during hypoglycemic shock. The amplitude of the b-wave seems to be proportional to the size of the retinal metabolic energy. The recovery period of the ERG after hypoglycemia is two to three times as long as that of the ECG. Glycogen reserves of the retina depend upon

the blood sugar level. They are utilized during hypoglycemia and restored during hyperglycemia. Especially, intermittent light stimuli are responsible for the breakdown of the retinal energy reserves. After utilization of the glycogen reserves of the retina, a correlation between the size of the b-wave and the blood sugar level becomes noticeable. A balance between supply and demand is established, and when normal quantities of oxygen are provided, the size of the b-wave completely depends on the blood sugar level. The energy reserves of the brain tissue seem to be smaller than those of the retina and do not become increased by a rise in the blood sugar level. (6 figures, 1 table, 29 references) Ernst Schmerl.

Recupero, Cenzo. **The lipidogram in diabetic retinitis.** Arch. di ottal. **59**:534-541, Nov.-Dec., 1955.

The alpha 1 and alpha 2 fractions were diminished and the rapid beta fraction augmented in eight patients with diabetic retinopathy. There is no parallelism between the behaviour of beta globulin and beta lipo-protein; an augmentation of the latter does not always coincide with one of the former. (14 references)

John J. Stern.

Schubert, G. **Action potentials of the human ciliary muscle in the living.** Arch. f. Ophth. **157**:116-121, 1955.

Special contact glass electrodes made possible the registration of action potentials of the human ciliary muscle. With contraction of the muscle a positive wave, with relaxation a negative deflection was found. (4 figures, 8 references)

Ernst Schmerl.

Schweer, G. **Glucosamine determination in the vitreous.** Klin. Monatsbl. f. Augenh. **128**:90-92, 1956.

The amount of glucosamine is an indirect clue to the amount of hyaluronic acid because the relative glucosamine content of the hyaluronidase molecule is constant. Protein glucosamine is minimal in the vitreous and does not exceed 3 percent of the total amount.

The glucosamine content of the whole vitreous was compared with that of a paper filtrate. The results were practically identical and this speaks against the theory that vitreous fibrils contain a large amount of hyaluronic acid, as only a small and varying amount of fibrils enters the filtrate. Hyaluronic acid is therefore concentrated in the interfibrillary vitreal fluid. (1 table, 13 references)

Frederick C. Blodi.

Schweer, G., and Suedhof, H. **The glucosamine of the vitreous body.** Arch. f. Ophth. **157**:85-91, 1955.

The authors were interested in the aging process of the vitreous. Vitreine is considered one of the essential substances found in the fibers of the vitreous while hyaluronic acid seems to be responsible for the viscous quality of the vitreous fluid. Hyaluronic acid is said to inhibit the breakdown of protein by collagenase, vitreine on the other hand seems to inhibit the activity of hyaluronidase. Glucosamine is an essential component of hyaluronic acid. The authors determined its amount in the vitreous of beef in relation to the age of the animal. They found average values of 99.45 $\gamma$/cm.$^3$ in calves, 246.64 $\gamma$/cm.$^3$ in grown animals up to 7 years of age and 168.32 $\gamma$/cm.$^3$ in older animals. Simultaneous determination of the dry weight of vitreous showed that total solids constantly increase with age. (2 figures, 3 tables, 17 references)

Ernst Schmerl.

Segal, P., Janiszewska-Geldner, B., Czechowska, Z., and Rudzki, E. **Effects of caffeine and urethane on the healing of eye burns in rabbits.** Postepy Okulistyki **1**:143-166, 1954.

Clinical and pathologic examination of 28 rabbits showed that the central nervous system affects the rate of healing uniform chemical burns of the rabbit's eye. Stimulation of the central nervous system with caffeine retarded the healing and in animals which were given urethane the reaction was milder and the course of healing shorter. (28 figures, 2 tables, 33 references) Sylvan Brandon.

Sobanski, J., and Szoslandowa, W. **Experimental investigation of the way of the aqueous outflow from the eye.** Postepy Okulistyki. 1:34-42, 1954.

Study of venous circulation shows that compression of the veins of the neck raises the ocular tension but ligation of the ophthalmic veins does not produce the same result. Compression of the aqueous and anterior ciliary veins was done by using the ophthalmodynamometer of Sobanski equipped with a ring 2 mm. wide which was just big enough to cover the area around the limbus. Pressures of 10, 20, 30 and 40 gms. for 2 minutes were used. Intraocular pressure rose and fell back gradually after about 16 minutes. The largest increase of pressure was 22 mm. Hg, the smallest 6 mm. When the pressure of the ring was applied unevenly, leaving part of the perilimbal area uncompressed, the pressure was reduced, not elevated. Pressure on the center of the cornea or on the lateral aspect of the sclera resulted in decrease of the intraocular pressure proportionate to the force applied. The authors conclude that the main outflow of fluid from the eye passes through the canal of Schlemm and the aqueous veins into the episcleral vein. The other channels for the outflow are secondary. The intraocular pressure depends on the amount of aqueous produced and of the aqueous outflow. (1 figure, 6 tables, 6 references) Sylvan Brandon.

Solomon, C., Light, A. E., and de Beer, E. J. **Cataracts produced in rats by 1,4-dimethanesulfonoxybutane (myleran).** A.M.A. Arch. Ophth. **54**:850-852, Dec., 1955.

1,4-dimethanesulfonoxybutane (myleran) is a carcinogenic substance in rats and closely resembles radioactive materials in its cataractogenic properties. (1 table, 10 references) G. S. Tyner.

Stemmermann, W., and Wallner, A. **Electrophoretic studies of the development of the lens in chick embryos.** Arch. f. Ophth. **156**:630-636, 1955.

The lenses of chick embryos from the fourth day of incubation to hatching were studied by paper electrophoresis. Only water soluble proteins are accessible in this method of analysis. In the earliest stage a group of proteins similar to the $\beta$ globulin of human serum is demonstrable; six or seven days later protein migration in the $\alpha 2$ and $\gamma$ segments occurred. The quantitative shifts in the lens of chick embryos were in many respects analogous to protein correlations in human eyes with senile cataract. (3 figures, 2 references) F. H. Haessler.

Stone, H. H., and Prijot, E. L. **The effect of barbiturate and paraldehyde on aqueous humor dynamics in rabbits.** A.M.A. Arch. Ophth. **54**:834-840, Dec., 1955.

A decrease in intraocular pressure with an increase in the facility of aqueous outflow was observed after the use of barbiturate anesthesia. (2 figures, 5 tables, 19 references) G. S. Tyner.

Trichtel, F. **Distribution of iodine in the eye of the living rabbit after oral percutaneous and local administration.** Arch. f. Ophth. **157**:149-157, 1955.

Radioactive iodine was determined after it had been given orally or by bathing or spraying the cornea. In each case

iodine was found. The optic nerve, the lens and the vitreous showed the smallest uptake. Sclera, cornea, aqueous and uvea were found to be richest in iodine. The experiments were performed in order to get an idea whether or not iodine might be of therapeutic value when applied the same way as described in these experiments. (1 figure, 4 tables, 22 references)

Ernst Schmerl.

Tron, E., and Tartakovskaya, R. **The action of some hormones on the lens.** Vestnik oftal. **34**:30-35, March-April, 1955.

Bovine lenses to which an extract of the parathyroid gland was added showed greater permeability to ascorbic acid than the other lens of the same animal. In a second series in which calves' lenses were used the action was similar but quantitatively less than in the lenses of the grown animals. In a third series adrenalin was used and this also led to the lowering of the permeability of the lens for ascorbic acid. It can be assumed that both the hormones act on the capsule and the lens fibers. The action of the hormone and the permeability of the lens can be regarded as factors which regulate the entrance of nutrient substances from the eye fluids into the lens and the removal from it of the metabolic products. (3 tables)

Olga Sitchevska.

de Vincentiis, M. **Recent studies on the alkali reserve of the aqueous.** Arch. di ottal. **59**:489-496, Nov.-Dec., 1955.

The alkali reserve of the aqueous humor is diminished during anesthesia with barbiturates (Nembutal). (1 table, 12 references)

John J. Stern.

Williams, D. B., Monahan, J. P., Nicholson, W. J., and Aldrich, J. J. **Biologic effects studies on microwave radiation.** A.M.A. Arch. Ophth. **54**:863-874, Dec., 1955.

Opacities can be produced in the eyes of anesthetized rabbits by single exposures to 12.3 cm. microwaves. As nearly as can be determined by ophthalmoscopic examination, all opacities are formed in the posterior lens segment and in some respects resemble lesions produced by certain ionizing irradiations. (5 figures, 4 tables, 15 references)

G. S. Tyner.

## 4

## PHYSIOLOGIC OPTICS, REFRACTION, COLOR VISION

Cogan, D. G., and Freese, C. G., Jr. **Spasm of the near reflex.** A.M.A. Arch. Ophth. **54**:752-759, Nov., 1955.

Sixteen cases of near reflex spasm are summarized and evaluated. The condition is usually functional, most often seen in the late adolescent period, and more common in females than males. Treatment consisted in the use of atropinization and minus lenses. (16 references)

G. S. Tyner.

François, J. Verriet, G., and de Rouck, A. **Congenital achromatopsy.** Bull. Soc. belge d'opht. **110**:170-255, June, 1955.

The different theories on the origin of achromatopsia with and without amblyopia are discussed; it is shown that with the typical form of achromatopsia there are numerous atypical varieties. A survey of the present knowledge on achromatopsia with special emphasis on the functional performances of the respective patients is given. The survey is based on 215 cases of complete achromatopsia with amblyopia, 15 cases of incomplete congenital achromatopsia with amblyopia, 14 cases of congenital achromatopsia without amblyopia and 2 cases of congenital unilateral achromatopsia with amblyopia (the only two cases in the literature).

The case histories of three patients, one male and two female, are reported in detail. The physical examinations were nega-

tive in two. The third had an abnormal EEG. Two patients had an abnormal fovea. Pseudo-photophobia and strabismus were present in all three. It was impossible to induce optokinetic nystagmus in any of the patients. Two patients had some binocular vision. There was a complete absence of color perception in all three and the luminosity curve was atypical. Central visual acuity in reduced illumination was normal. The photopic visual acuity was less than 0.2. The peripheral photopic visual performance was better than normal in one patient. The photopic fields were characterized by central scotoma and disturbances in the spatial summations. The subjective and objective critical fusion frequency was reduced. The adaptation curve was biphasic. In a scotopic environment the b-wave of the ERG was normal, the x- and a-waves were extinguished. There was no history of heredity in any of the three patients. (25 figures, 5 tables, 210 references) Alice R. Deutsch.

Friede, Reinhard. **Surgical treatment of progressive myopia.** Klin. Monatsbl. f. Augenh. **128**:57-61, 1956.

The danger of progressive myopia is the overstretching and tearing of retina and choroid. This damage could be avoided if these layers were freely movable and not anchored to the disk and the scleral spur. They may become movable after extensive cyclodialysis.

The cyclodialysis is done over the entire temporal segments with the multiple thrust method and using different spatules. Blood is sucked out of the anterior chamber. Of 10 patients who could be re-examined after seven years, eight showed a complete arrest of the myopia and in two there was improvement.

Frederick C. Blodi.

Gardiner, Peter A. **Physical growth and the progress of myopia.** Lancet **2**:952-953, Nov. 5, 1955.

The differential growth rates of active and stationary myopia were studied for a year. Myopia increases during periods of rapid growth. The more active the myopia, the greater were the changes in growth, with few exceptions. (5 figures, 3 tables, 1 reference)

Irwin E. Gaynon.

Hamasaki, D., Omg, J., and Marg, E. **The amplitude of accommodation in presbyopia.** Am. J. Optometry **33**:3-14, Jan., 1956.

The amplitude of accommodation was measured on 106 subjects, aged 42 to 60 years, by the "push-up" and stigmatoscopic methods. Absolute presbyopia in this group occurred at the age of 52 years.

Paul W. Miles.

Hansen, A. K., and Swanljung, H. **Studies on the clinical investigation of retinal correspondence.** A.M.A. Arch. Ophth. **54**:744-751, Nov., 1955.

The authors evaluate the use of two tests for retinal correspondence, the prism rack test and the tests utilizing the phi phenomenon. Neither test is recommended for clinical use but both are of value in helping one to understand visual "pathophysiology." (4 figures, 1 table, 10 references) G. S. Tyner.

Harms, H., and Aulhorn, E. **Contrast phenomena along the borderline separating two areas with different brightness values.** Arch. f. Ophth. **157**:3-23, 1955.

The authors studied the sensitivity of definite retinal areas to brightness differences. They used methods of their own and found the sensitivity to brightness differences diminished along the borderline between two areas having different brightness. This decrease of sensitivity might represent an inhibitory function of these retinal areas. It possibly counteracts the indistinctness of the retinal

images which results from physical cause. (8 figures, 1 table, 19 references)
Ernst Schmerl.

Jampolsky, A., Flom, B. C., Weymouth, F. W., and Moses, L. E. **Unequal corrected visual acuity as related to anisometropia.** A.M.A. Arch. Ophth. **54**:893-905, Dec., 1955.

200 patients with anisometropia of at least 1.00 D were reviewed. Unequal corrected vision is more common in hyperopes than myopes. Other important factors are astigmatism, suppression, aniseikonia, and failure of early correction of refractive errors. (7 figures, 7 tables, 47 references) G. S. Tyner.

Kleberger, E., **Flicker fusion frequency in normal and abnormal vision.** Arch. f. Ophth. **157**:158-166, and 167-182, 1955.

The purpose of the two papers is to study the peripheral visual field using test objects of a definite size, surface brightness and flicker fusion frequence. Best conditions with normal persons were obtained when the test objects had a diameter of 11 mm., a surface brightness of from 150 to 300 apostilb and a flicker fusion frequency of from 38 to 44 Herz. The author also studied 100 pathologic cases. He feels that flicker perimetry is more sensitive than ordinary perimetry, especially when there is a lesion of the optic nerve or brain, papilledema, and glaucoma. (14 figures, 6 tables, 32 references) Ernst Schmerl.

Koch, Carel C. **Minor suggestions to improve refractive care.** Am. J. Optometry **33**:15-23, Jan., 1956.

This is an interesting discussion of methods of handling patients by the editor of the Am. J. Optometry. The "chairside manner" and smallest detail may be of great importance for consistent results. The family history must not be ignored, since diseases like diabetes are closely related to refraction. History should be taken by the doctor, not the secretary. Orthoptics will benefit less than 15 percent of office patients, and should not be overemphasized. The refraction room should be bright and cheerful for as many tests as possible. Only retinoscopy, ophthalmoscopy, and the Maddox rod test require reduced illumination. The patient should be moved from one instrument to another, not kept in the same chair for all the tests. Paul W. Miles.

Lau, E., Muetze, K., and Weber, G. **The chromatic aberration of the eye.** Arch. f. Ophth. **157**:92-100, 1955.

The authors studied the chromatic aberration of the eye with the help of a special refractometer and a double monochromator. They found differences of about two diopters between light of short wave length and that of long wave length with errors of about $\pm 0.05$ D for each reading. On the basis of their measurements the authors feel that there is no reason to assume the participation of several retinal layers in color vision. (7 figures, 1 table, 7 references)
Ernst Schmerl.

Nadell, M. C., and Knoll, A. **The effect of luminance, target configuration and lenses upon the refractive state of the eye. Part 1.** Am. J. Optometry **33**:24-42, Jan., 1956.

Accommodation is most precise on a letter like "E," and least precise on a blank wall. The factors of target size and contrast are very important in consideration of nocturnal and sky myopia.
Paul W. Miles.

Schumacher, C. F., and Lauer, A. R. **Laboratory analysis of a group screening test for visual acuity.** Am. J. Optometry **32**:647-659, Dec., 1955.

Methods of visual screening of groups instead of individuals are discussed.
Paul W. Miles.

Sloan, L. L., and Habel, A. **Tests for color deficiency based on the pseudoisochromatic principle.** A.M.A. Arch. Ophth. **55**:229-239, Feb., 1956.

The authors report on their successful effort to find a better set of diagnostic plates for screening test for red-green color deficiency. (2 figures, 10 tables, 18 references) G. S. Tyner.

Stams, A. **Acquired color blindness after typhus.** Klin. Monatsbl. f. Augenh. **128**: 75-80, 1956.

A 40-year-old man noticed after an attack of typhus that most colors appeared gray to him and that only blue could be recognized. Photophobia developed. Central vision remained, but the dark adaptation was reduced. A cerebral lesion was assumed to be the cause of this extensive color blindness. (9 references)
Frederick C. Blodi.

Starkiewicz, W. **Pathological types of retinal correspondence.** Postepy Okulistyki **1**:107-114, 1954.

The author examined 348 cases of squint, 256 of them convergent and 92 divergent, to determine the condition of their retinal correspondence. The convergent squints could be divided into five groups depending on the relation of the degree of the deviation to the position of the false macula. He classified those in which fixation with the squinting eye increased the angle of deviation as above normal, and those in which the angles were equal as normal. When the angle of fixation was smaller than the angle of squint the author distinguishes three groups, the last one comprising cases in which the false macula is at the angle of squint. The author similarly divides divergent squint into five groups: normal, first, second and third degree of false correspondence, and paradoxical. The type of correspondence was little influenced by monocularity or alternation. It was definitely related to the time of onset and the duration of the squint. (2 figures, 2 tables) Sylvan Brandon.

Stern, John J. **Transient myopia in case of dermatitis treated with corticotropin.** A.M.A. Arch. Ophth. **54**:762, Nov., 1955.

A case of transient myopia occurring in a patient with poison ivy dermatitis treated with corticotropin is reported. An explanation is solicited. G. S. Tyner.

Trincker, D., and Trincker, I. **The ontogenetic development of light and color sense in man.** Arch. f. Ophth. **156**:519-534, 1955.

By means of the "eye reflex on the neck" which was described by Pieper, the authors determined the relative intensities of monochromatic light for light and dark adaptation in mature and immature new-born infants during their first 10 weeks of life. The values for light adaptation are much like those in the adult at all stages of development. For dark adaptation the values are significantly different and only approximate adult values after a period of development which may be as long as 10 weeks in prematurely born infants. The final scotopic values are reached first in the middle of the spectrum (yellow and yellow-green), then at the red end of the spectrum and finally in the blue. In all stages of extrauterine development the differences in photopic and scotopic vision occur which bring about the Parkinje phenomenon. In this the authors' findings differ from similar measurements which Birukow found in the frog. Contrary to the assumption of v. Kries, the authors found that the morphologic and functional development of the cones has priority over that of the rods. (62 references) F. H. Haessler.

Venturi, G., and Guzzinati, G. C. **The changes of corneal astigmatism after surgery on the inferior oblique muscle.** Ann. di ottal. e clin. ocul. **81**:441-446, Oct., 1955.

In ten cases of recession or marginal myotomy of the inferior oblique muscle the authors found an increase of the dioptric power of both horizontal and vertical meridians with a tendency towards astigmatism with the rule in six or seven patients. In seven cases the axis changed in the sense of an inclination towards the nasal side. (3 tables, 7 references)

John J. Stern.

Westheimer, Gerald, **Measuring bifocal additions.** Am. J. Optometry **32**:660-664, Dec., 1955.

Two methods of measuring the power of the bifocal segment in the vertometer are described. Paul W. Miles.

## 5

### DIAGNOSIS AND THERAPY

Aguilar Munoz, J., and Del Rio Cabanas, J. L. **Conservation and supply of human cadaver corneas.** Arch. Soc. oftal. hispano-am. **15**:1075-1082, Sept., 1955.

The authors demonstrated the advantage of using corneas as promptly after enucleation as possible by a microscopic study of corneas excised six hours after death, and preserved in formalin after various periods of conservation at a low temperature. One series of eyes was put into formalin immediately, and others after preservation in a humid chamber at a temperature of 2 to 4 degrees C for 12, 24, 48, and 72 hours. The microscopic data show the onset of degenerative changes after 24 hours of conservation. After 48 hours definite signs of tissue death are present in the parenchyma and endothelium. (6 figures) Ray K. Daily.

Arruga Forgas, Alfredo. **Plastics in ophthalmology.** Arch. Soc. oftal. hispano-am. **15**:815-1014, July-Aug., 1955.

This is the most complete monograph on this subject in the literature. After a review of the literature on the general characteristics of the various types of plastic materials, the monograph covers all phases of the use of plastics in ophthalmology, such as adhesive solutions, bandages, occlusive shields, plastic sponges, lenses and mountings, contact lenses, molding material for contact lenses, prosthesis for symblepharon, orbital postenucleation and postevisceration implants, sutures, artificial tears, lacrimal tubes, lenses for inclusion into the cornea and into the anterior chamber, Ridley lenses, inclusions in experimental glaucoma, substitutes for vitreous, implants into the lid for sunken lids, substitution for parts of the orbit, such as the maxilla or trochlea, component parts of solutions and ointments, and technical application in anatomy and histology. The literature on each of these subjects is thoroughly reviewed, and a bibliography follows each chapter. (100 figures, 942 references)

Ray K. Daily.

Barraquer Moner, J. **Artificial hibernation (potentialized anesthesia) in ophthalmic surgery.** Arch. oftal. Buenos Aires **30**:283-310, Aug., 1955.

Under the name of pharmacodynamic potentialization, the author describes that procedure which consists in depressing transitorily the cerebrospinal and the autonomic nervous systems through the combined use of different drugs, in order to achieve a complete sedation not only in the form of a twilight state but also in that of a systemic and local muscular relaxation. All anxiety and untoward reflexes being thus inhibited, occasionally for as long as several days, the procedure pays high dividends whenever the high-strung type of patient is submitted to a major ocular operation.

The desired effect is reached by means of the carefully planned administration of barbituric, ganglioplegic, analgesic, parasympathicolytic, sympathicolytic and curare-like drugs. While data on the

fundamentals of the technique involved and on the required dosages are given in this paper, a more complete presentation is to be found in a monograph recently published by the author (Potencialización Farmacodinámica en Oftalmología, Barcelona, Instituto Barraquer, 1954). Of this, a somewhat shorter summary has also appeared elsewhere (Ophthalmologica 129:400-404, June, 1955).

A. Urrets-Zavalia, Jr.

Carroll, F. D., and de Roetth, A., Jr. **The effect of retrobulbar injections of procaine on the optic nerve.** Tr. Am. Acad. Ophth. **59**:356-365, May-June, 1955.

A series of 28 eyes in 26 patients was studied with the purpose of ascertaining what effect the retrobulbar injection of procaine may have. Four of the 26 patients were chosen to serve as controls; two of them were given an injection of 2 cc. saline solution and two saline solution with hyaluronidase added. The other 22 patients were given injections of procaine solution in concentrations of 2- to 8-percent, with or without hyaluronidase. Within a few minutes after the injection, which was like that used by surgeons for complete motor block, a reduction of vision from slight to total was noted. In 10 of the 12 patients who were given 8-percent procaine solution, vision was reduced to less than 20/200. This may have value during cataract extraction. No harmful effects were noted and in all patients the vision became normal in 30 to 120 minutes. (10 figures, 3 tables, 7 references) Theodore M. Shapira.

Celeste, J., Castro, M. D., and Krug, Filho, A. **Opening of the anterior chamber with a Gillette razor blade.** Rev. brasil. oftal. **14**:439-450, Dec., 1955.

The authors describe their new method of opening the anterior chamber in cataract surgery with a portion of a Gillette razor blade which has been mounted in a special handle. The authors feel that the incision ab externo has great advantages, especially if combined with two preplaced sutures, that the technique is easy and the resulting wound had the advantage of smooth healing. Once the initial incision has been made with the razor blade, the wound is enlarged with scissors.

Histologic studies on rabbits showed perfect scar formation. The results the postoperative ophthalmometric measurement and the visual acuity obtained in 25 cases are tabulated. (8 figures, 3 tables)

Walter Mayer.

Davis, E., and Landau, J. **Capillary microscopy in rheumatic fever. The capillary patterns in conjunctiva and nailbed as clinical signs in rheumatic fever and rheumatic heart disease.** Arch. Int. Med. **97**:51-56, Jan., 1956.

The authors studied the capillaries of the conjunctiva and the nailbed with the slitlamp or capillary microscope in 100 patients with acute rheumatic fever or rheumatic heart disease. A characteristic capillary pattern was found in a much greater number of these patients than among normal subjects. In the conjunctiva there is a characteristic arborization of the vessels and abrupt reduction in caliber of many terminal branches. The difference between this pattern and the usual interlacing vascular latticework is striking. The authors point out that the onset of this phenomenon may antedate the rheumatism and may be a sign of rheumatic diathesis. The capillary sign may help in diagnosis in questionable cases and justifies study of the symptomless patient for evidence of rheumatic heart disease. (3 figures, 2 tables, 12 references) F. H. Haessler.

Dekking, Henry M. **Use of the binocular microscope in eye operations.** A.M.A. Arch. Ophth. **55**:114-117, Jan., 1956.

The author calls attention to the inconsistency in making diagnoses with the binocular microscope with a magnification of 10 to 40, and then doing surgery with the naked eye.

A modification of the otoscope used for fenestration operations is described. A perfect headrest is essential. It is stressed that at first it is unnatural, and difficult to use the apparatus, but with patience the surgeon develops a new feeling of assurance. At last it becomes possible to perform difficult operations with a subtlety and certainty much greater than with the naked eye. (4 figures)

G. S. Tyner.

Fanta, H. **Conjunctival suture in enucleation with insertion of an implant.** Arch. f. Ophth. **157**:183-187, 1955.

The author closes the conjunctival wound by introducing the one flap of conjunctiva into a slit in the opposite conjunctiva flap. The slit is made by splitting the latter into two layers parallel to the conjunctival surface. (2 figures, 4 references)

Ernst Schmerl.

François, J., Verriest, G., and de Rouck, A. **Electro-oculography as a functional test in pathological conditions of the fundus. 1. First results.** Brit. J. Ophth. **40**:108-112, Feb., 1956.

The authors describe their technique in obtaining the results presented in various typical diseases of the choroid and retina. Electrooculography was used with a standard method as an indirect estimation of the standing potential in conjunction with other functional tests in normal and pathological cases. There is no direct correlation with electroretinography, which seems to be more rapidly effected. Too low values were found primarily in cases of microphthalmos, primary pigmentary degeneration of the retina, cicatricial chorioretinitis and in retinal detachment. (4 figures, 6 references)

Lawrence L. Garner.

Gandolfi, Alberto. **Anesthesia in eye surgery of children.** Ann. di ottal. e clin. ocul. **81**:467-475, Oct., 1955.

Various types of surgical anesthesia for children are discussed. The importance of preparation for abolishing psychologic trauma is stressed and endotracheal intubation is recommended. (29 references)

John J. Stern.

Gordon, D. M., and Ritter, C. **Magnification.** A.M.A. Arch. Ophth. **54**:704-716, Nov., 1955.

The employment of magnifying devices for rehabilitation of the visually handicapped has been neglected by ophthalmologists. This article describes some of the available devices and the indications for their use. Many useful suggestions are given concerning the prescribing of these devices. A four-diopter lens gives one unit of magnification. The power of any magnifying device is found by the formula $10/F = \text{Power}$. (F refers to the focal length of the lens.) In general, the lens which provides the minimum required magnification is best because it allows a greater and a less critical working distance. Adequate lighting is of prime importance in the use of any magnifying device. Ordinary light sources may be inadequate.

The following low vision aids are presently available: 1. Spectacles with high reading additions of as much as 10 to 12 diopters or more (as bifocals, reading glasses, or the Policoff type lens). 2. Magnifying glasses with or without supporting devices, and with or without built-in illumination. 3. Projection instruments which give magnifications of as much as 25 diameters. 4. Contact glasses, with and without the use of other vision aids. 5. Telescopic lenses (distant and

near vision); monocular only for near vision. 6. Microscopic lenses (near vision only), monocular only. The authors call attention to the advantages and disadvantages of each device. (5 figures, 5 references) G. S. Tyner.

Grotefendt, Gotthard. **Isotonicity of eye drops.** Klin. Monatsbl. f. Augenh. **127**: 750-753, 1955.

The author is a pharmacist who discusses the practicability of isotonic and/or buffered eye solutions. The initiative came from Goldmann and the author hopes that the German pharmacopoeia will soon follow the example of Switzerland in integrating buffered, isotonic eye solutions. Frederick C. Blodi.

Harrington, D. O., and Flocks, M. **The multiple pattern method of visual field examination.** Tr. Am. Acad. Ophth. **59**: 126-142, March-April, 1955.

The authors describe a rapid and simple screening method of visual field examination used in over 500 subjects and 100 with abnormalities. They suggest that it is not a substitute for standard perimetric techniques, but rather a supplement. (12 figures, 1 table, 4 references) Theodore M. Shapira.

Jacobson, Jerry Hart. **A new contact lens electrode for clinical electroretinography.** A.M.A. Arch. Ophth. **54**:940, Dec., 1955.

A new contact lens electrode for electroretinography is introduced. It is said to eliminate much of the discomfort associated with the procedure. It is manufactured by Obrig Laboratories. (1 figure) G. S. Tyner.

Kittel, V. **Photophobia.** Klin. Monatsbl. f. Augenh. **128**:34-42, 1956.

Photophobia is the abnormal reaction of a pathologically changed sensory system to a normal light stimulus. The cause may be an inflammation of the nose, the cornea (especially herpes and phlyctenular keratitis) or the iris. Other reasons for photophobia are affections of the retina (especially complete color blindness), the optic nerve and systemic infections, often of a viral nature. However, not all the patients with such conditions develop photophobia and patients with pathophobia are often nervous and labile. An injection into the ciliary ganglion alleviates the complaints immediately and dark adaption is normal. These points are discussed on the basis of seven cases. A hypersensitivity of vegetative cerebral centers is assumed. (24 references) Frederick C. Blodi.

Kruemmel, H. **A ball-joint for the giant magnet.** Klin. Monatsbl. f. Augenh. **127**: 753-754, 1955.

The author constructed a ball-joint which connects the thin spatula with the magnet. This facilitates extraction of the foreign body. (3 figures) Frederick C. Blodi.

Lederman, M. **Some applications of radioactive isotopes in ophthalmology.** Brit. J. Radiol. **29**:1-12, Jan., 1956.

The author discusses the use of radio isotopes in the therapy of extra- and intraocular neoplasms and of Mooren's ulcer. Both beta and gamma ray applicators are described. As might be expected, best results are obtained in the treatment of epibulbar melanomata where the lesion is easily accessible to the applicator. Mooren's ulcers, intraocular neoplasms and corneal vascularization respond less well. (20 figures, 7 tables, 6 references) David Shoch.

Marin-Amat, M. **Intrascleral implants and ocular prosthesis.** Arch. Soc. oftal. hispano-am. **15**:1027-1038, Sept., 1955.

The author reviews the evolution of the enucleation and evisceration opera-

tions, and is in complete accord with Berens and Rosa that evisceration is preferable. He uses Poulard's oval glass intrascleral implants. The technique of the operation is described. It differs from the conventional technique in that the sclera and conjunctiva are closed with the same sutures, the needles going through conjunctiva, sclera, sclera and conjunctiva again. Heavy silk is used for the sutures. (6 figures, 1 table, 14 references)

Ray K. Daily.

Nano, H. M., Frigerio, E., and Scenna, M. A. **Modified Sato operation for anterior synechia.** Arch. oftal. Buenos Aires **30**:337-339, Sept., 1955.

Eleven patients with anterior synechia were successfully operated on by means of the procedure advocated by Sato (Sato, T.: Am. J. Ophth. 36:698-704, May, 1953) which consists of stripping off the adhesion with a special corneal knife introduced into the anterior chamber through a limbal puncture. In order 1. to stretch the iris band so as to facilitate its severance, 2. to minimize the risk of injury to the lens capsule, 3. to gain a better view of the structures concerned and 4. to lessen the possibilities of a postoperative hyphema, the authors consider it convenient to replace the aqueous humor by a large air bubble prior to the synechiotomy.

A. Urrets-Zavalía, Jr.

Numao, C. **Effect of the ultrasonic wave on the blood protein fraction.** Acta Soc. Ophth. Japan. **59**:1804-1813, Dec., 1955.

When an ultrasonic wave is applied to serum in vitro, alpha globulin in it is apt to increase and gamma globulin is apt to decrease. The analysis is made by Tisselius and paper electrophoresis. In some ocular conditions such as pigmentary degeneration of the retina, ocular allergy, hypertension and optic nerve disorders, these changes in the blood protein fractions are apt to be greater than in normal man. Numao suggests that the analysis may assist in the diagnosis of some ocular conditions. (3 figures, 6 tables, 9 references)

Yukihiko Mitsui.

Palmerton, E. S. **Transillumination through everted lid to visualize foreign bodies.** A.M.A. Arch. Ophth. **55**:186-187, Feb., 1956.

Palmerton reports on four cases in which he was able to see foreign bodies, particularly vegetable fibers, in the upper culdesac by transillumination with a Finnoff transilluminator held behind the everted upper lid. (2 figures, 1 reference)

G. S. Tyner.

de Rezende, C., de Carvalho, C. R., and Queiroz Salgado, L. **Antibiotics and chemotherapeutic agents in ophthalmology.** Rev. brasil. oftal. **14**:405-433, Dec., 1955.

The authors describe the properties, administration, absorption and specific action of the various chemotherapeutic and antibiotic agents used in ophthalmology. They briefly review therapeutic indication in the more common ocular diseases. (2 tables, 122 references)

Walter Mayer.

Riegelman, S., Vaughan, D. G., Jr., and Okumoto, M. **Rate of sterilization as a factor in the selection of ophthalmic solutions.** A.M.A. Arch. Ophth. **54**:725-732, Nov., 1955.

The danger of infection with Pseudomonas aeroginosa has been a problem difficult to cope with. The authors have shown that polymyxin B sulfate (1000 units per cc.) is the most rapidly acting chemical preservative used. (19 references)

G. S. Tyner.

Rotter, H. **The theory of slitlamp microscopy of the fundus.** Arch. f. Ophth. **156**:503-518, 1955.

The author points out the advantage of the convex lens in highly myopic eyes over the strong concave lens which is used in the inspection of the fundus with the slitlamp and microscope. He provides a detailed analysis of the optical principles. (8 figures, 2 tables, 4 references) F. H. Haessler.

Rubin, L. R., and Walden, R. H. **Seven year evaluation of polyethylene in facial reconstructive surgery.** Plast. & Reconstruct. Surg. **16**:392-405, 1955.

Polyethylene plates of many forms and various shapes were used in 135 cases over a period of seven years. Though many of those used for ear and nose implants were impermanent, none of the seven placed on the orbital floor to elevate the globe in old depressed fractures has required removal. The globes have never shown signs of reaction. Polyethylene can be used to replace either bone or cartilage but its properties resemble those of bone more than those of cartilage. Alston Callahan.

Sinclair, W. K., and Trott, N. G. **The construction and measurement of beta-ray applicators for use in ophthalmology.** Brit. J. Radiol. **29**:15-23, Jan., 1956.

A strontium applicator for beta radiation of the eye is described. It differs from the applicator in general use in the United States in that the radioactive material is bonded in silver and this "foil" embedded in a plastic contact lens. This applicator has several advantages: it need not be hand held, the location of active "foil" may be varied in the lens and the dosage thus controlled. For the diminishing list of indications for beta therapy this applicator seems to be advantageous. (12 figures, 1 table, 12 references) David Shoch.

Tani, G. T., Ogle, K. N., Weaver, R. W,. and Martens, T. G. **On the precise objective determination of eye movements.** A.M.A. Arch. Ophth. **55**:174-185, Feb., 1956.

It has been generally assumed that in the prism-vergence tests, as soon as the images of a test target are seen double, the eyes immediately revert to the heterophoria (fusion free) position. There is evidence, however, that the tonicity of the extraocular muscles caused by the gradual increase in forced convergence (or divergence) is maintained to a certain degree for a considerable time after the stress is eliminated. The purpose of this paper is to describe the apparatus used for the objective determination of the eye movements, and to analyze the discrepancies under conditions of stress. This study shows that a precise measurement of the actual convergence of the eyes is not possible, owing to a displacement of the corneal reflex images associated with the eye movements. (5 figures, 17 references) G. S. Tyner.

Terner, I. S., Leopold, I. H., and Eisenberg, I. J. **The radioactive phosphorus ($P^{32}$) uptake test in ophthalmology.** A.M.A. Arch. Ophth. **55**:52-83, Jan., 1956.

Of the 262 patients studied, 233 had intraocular lesions and 29 had extraocular lesions. A new criterion for positivity was established. The test is considered positive when in one hour there is an uptake over 30 percent greater than the normal, and in 24 hours there is an increase beyond the one-hour calculation. In lid lesions the test is also considered positive if the one-hour calculation is over 100 percent greater than normal.

There were five false negative tests in the series of six cases of retinoblastoma. Of the 29 cases of adnexal lesions there was one false negative test.

$P^{32}$ uptake studies are a valuable aid in the differential diagnosis of intraocular lesions, provided that the lesion is within reach of the counter tube. No correlation

could be made between the $P^{32}$ uptake measured in vivo as "percent greater than normal" and the cellular type of the malignant melanoma studied in vitro after enucleation.

The validity of the $P^{32}$ uptake test depends upon 1. the ability of malignant tissue to concentrate $P^{32}$, 2. the capacity of malignant tumor tissue to retain $P^{32}$ over a period of time, and 3. the faculty of normal tissues to excrete their initial concentration of $P^{32}$ rapidly. (23 figures, 4 tables, 81 references) G. S. Tyner.

Trott, N. G., and Sheatley, B. M. **Tantalum 182 wire gamma-ray applicators for use in ophthalmology.** Brit. J. Radiol. **29**:13-14, Jan., 1956.

The authors describe two applicators containing tantalum$^{182}$ as a source of gamma rays for the irradiation of retinoblastomas and cancerous melanosis. The applicators are rings of 2 and 4 cm. diameter, the first of which is inserted into a contact lens and the second into a plastic face mask. Data for dosage are given. (1 figure, 2 tables, 4 references)

David Shoch.

Villaseca, Alfredo. **New mercury vacuum pump and system of slowly applied vacuum for phakoerisis.** A.M.A. Arch. Ophth. **55**:9-20, Jan., 1956.

The author says there are fewer broken capsules when one uses the suction method because one pulls on a larger area of the capsule, whereas the forceps pinch a small area. He mentions the usual advantages and objections to both the instrument with motor and the one with the syringe or rubber bulb. To overcome the objections, he has devised an apparatus which is both a vacuogener and vacuometer in which the vacuum is produced by a mercury column at variable heights. He lists the advantages. The instrument is free from mechanical faults, requires little maintenance, has a variable vacuum from one to 70 cm. Hg, works gently and noiselessly, has no air valves, it provides slowly increasing suction, exact measurement of vacuum, and steadiness of a mercury column as an index to firmness of grasp. The force of adhesion is compared to that in other instruments and other interesting data are given. (21 figures, 3 tables, 16 references) G. S. Tyner.

Volkova, M. **The use of novocaine block in hypertension with fundus changes.** Vestnik oftal. **34**:17-21, March-April, 1955.

Retrobulbar injections of 0.25 percent novocaine (combined at times with periorbital injections) were applied in 31 patients who had changes in the fundus. The treatment was most effective in the initial stage of hypertension. The best results were obtained in patients with recent occlusions of the central retinal artery; the vision, visual fields and the central scotoma were greatly improved and there was no regression during the next one to five years. Early retinopathy also responded to the treatment. In the late stage of hypertension the novocaine injection did not change the fundus picture. The injections were given two to three times with an interval of ten days. Headaches, insomnia and nervousness were also improved. The author believes that the novocaine "blocade" acts on the pathological local changes of the retina through the central nervous system.

Olga Sitchevska.

Yanagida, H. **The Menkin test in ocular diseases.** Acta Soc. Ophth. Japan **59**: 1544-1549, Sept., 1955. **Relation of Menkin test to Amsler-Huber test in ocular diseases.** Ibid. **59**:1829-1830, Dec., 1955.

The Menkin test, which depends on an increase in capillary permeability probably due to leukotaxine, is positive in glaucoma, retinal periphlebitis, detach-

ment of the retina, ocular infections and acute attacks of ocular allergy. It is negative in normal man and in persons with such noninflammatory ocular conditions as cataract.

In the second report, Yanagida states that the results of the Amsler-Huber test, in which the permeability of the aqueous barrier is examined, are different from those of the Menkin test. Therefore, the permeability of the aqueous barrier is not conditioned by the capillary permeability. (3 figures, 6 tables, 10 references)

Yukihiko Mitsui.

## 6

## OCULAR MOTILITY

Alpern, Mathew. **Testing distance effect on phoria measurement at various accommodation levels.** A.M.A. Arch. Ophth. **54**:906-915, Dec., 1955.

The author reports experiments designed to explain the reason for the differences between phoria determinations at different distances. After reading the article the abstractor is still at a loss for a suitable explanation. (5 figures, 2 tables, 19 references) G. S. Tyner.

Frey, R. G. **Disturbances of motility after surgical treatment of retinal detachment.** Arch. f. Ophth. **156**:561-565, 1955.

Among 54 patients in whom surgical treatment for retinal detachment had been successful, 19 had a disturbance of function of an extrinsic ocular muscle. Diathermy coagulation was not followed by a disturbance of motility, whether the muscle had been temporarily resected or not, unless the coagulation was done in an area of sclera directly under the muscle, and in this case the action of that muscle was strengthened. Scleral excision was frequently followed by weakness of that temporarily resected muscle which passed over the incision. This effect can be avoided by shortening the tendon of the muscle before replacing it. (2 tables, 7 references) F. H. Haessler.

Guzzinati, G. C. **The action and significance of the "transfer test" in the examination of retinal correspondence.** Ann. di ottal. e clin. ocul. **81**:455-466, Oct., 1955.

The after-image transfer test is a valuable modification of the classical Bielschowsky method and is particularly useful in patients with alternating strabismus and amblyopia. (9 references)

John J. Stern.

Guzzinati, G. C. **The effect of surgery on the inferior oblique muscle on horizontal heterotropia.** Ann. di ottal. e clin. ocul. **81**:447-454, Oct., 1955.

No definite horizontal variation was observed in 24 cases of surgical intervention on the inferior oblique muscle. (1 table, 31 references) John J. Stern.

Hoffman, R., and Krueger, C. **The determination of capillary resistance in the conjunctiva.** Arch. f. Ophth. **156**:656-665, 1955.

The authors used the method of Thomas and Gerard to measure the capillary resistance in 233 patients and in 116 normal subjects for comparison. Among normal subjects 50 years of age or less, 90 percent showed a normal capillary resistance whereas only 70 percent of those older than 50 years were normal. The resistance was normal in 90 percent of normal subjects under 50 years of age and in only 70 percent of those older than 50 years. No abnormal fragility was found in patients with a rheumatic disease; capillary resistance was normal in only 60 percent of patients with cardiovascular disturbances; surprisingly, it was normal in 90 percent of diabetics. (2 tables, 6 references) F. H. Haessler.

Jampolsky, Arthur. **Characteristics of suppression in strabismus.** A.M.A. Arch. Ophth. **54**:683-696, Nov., 1955.

It is the purpose of this paper to emphasize the clinical advantage of simplicity in testing procedures in the determination of the characteristics of suppression in patients with strabismus, to outline the quantitative and qualitative aspects of suppression by clinical and laboratory tests, and to point out the importance of the hemiretinal border (at the decussation line) in the regional suppression found in strabismus. The author feels that some clinical tests for suppression such as the major amblyoscope and Worth four dot are often superfluous and give little or no information as compared with simple clinical tests. One may demonstrate a region of suppression confined to the nasal retina in esotropia and temporal retina in exotropia. (3 figures, 11 references) G. S. Tyner.

Junghannss, K. **Total ophthalmoplegia after influenza.** Klin. Monatsbl. f. Augenh. **128**:86-88, 1956.

A 42-year-old woman developed complete internal and external ophthalmoplegia of the right eye four weeks after an attack of influenza. The condition improved very slowly. (15 references)
Frederick C. Blodi.

Mackensen, G. **The physiology of optokinetic nystagmus.** Arch. f. Ophth. **156**: 535-546, 1955.

The author shows that the usual interpretation of recordings of nystagmus curves in which average values for amplitude and frequency are used may be fallacious. Average values are admissible only when the tracings are taken with adjustment to a median range of oscillation. (8 figures, 6 references)
F. H. Haessler.

Nordlöw, W. **Permanent convergent squint—early operation and long-term follow-up.** A.M.A. Arch. Ophth. **55**: 87-100, Jan., 1956.

The author reports the method of follow-up and the results in 70 patients with convergent squint who had been operated upon early and who had had no orthoptic training. In this series the esotropia commenced at the age of six months or later and they were operated upon six months to four years after the development of the squint. After one to three operations about 75 percent obtained binocular fixation. Sixty-four patients were followed until their average age was 11.3 years. Of the patients with binocular fixation, one-third had orthophoria and two-thirds heterophoria at the final examination; about 57 percent were cured, with good binocular vision; 15 percent had defects in binocular vision; and 15.6 percent had cosmetic cure only. The visual acuity of the squinting eye was less than 0.3 in 5 eyes and greater than this in the remainder. (16 tables, 25 references) G. S. Tyner.

Pallares, J. **Concepts on the surgical treatment of strabismus.** Arch. Soc. oftal. hispano-am. **15**:1054-1069, Sept., 1955.

The author's reasons for this presentation are the probable presence of 120,000 cases of strabismus in Spain, the loss of visual acuity in untreated squinting eyes, the psychologic disturbances suffered by cross-eyed children, and the industrial handicap of monocular vision. These facts support the author's opinion that there is an urgent need for developing orthoptic treatment in Spain, for the education of pediatricians to the importance of early treatment of strabismus, and for a campaign among teachers, visiting nurses and the public in general advocating the provision of a preschool ophthalmologic examination for every child. The two surgical patterns of strabismus management, that of Lyle and Jackson, and that of Foster are quoted. The difference in the management of strabismus with the goal of restoration of physiologic function, and

that of a purely cosmetic correction is pointed out. With restoration of physiologic function, as a goal, orthoptic exercises, wearing of glasses, and occlusion for amblyopia should be tried for one year and one half prior to surgery, particularly if the degree of deviation shows a tendency to diminish. In deviations of over 30 degrees and in case of failure to eliminate anomalous correspondence by orthoptic training, surgery is indicated. The surgical procedures practiced by Pallares include recession, myectomy, marginal myotomy and tenotomy of the rectus externus muscle. The author advocates complete corrections of strabismus in the preschool age. (3 figures, 2 references)

Ray K. Daily.

Whitwell, J., and Preston, A. **Use of miotics in squint surgery.** Brit. J. Ophth. **40**:96-99, Feb., 1956.

The authors use miotics in those patients who have esotropia, have been operated upon, and present a residual esotropia at near while showing parallelism at distance. If this therapy is to succeed, the patient must have good binocular vision and at least fairly good stereopsis. If these two factors are present, the use of 1-percent pilocarpine solution three times daily is recommended for 30 days and twice daily for two additional weeks. Orthoptic training is advised with the use of miotic therapy. (1 figure, 1 table, 3 references)

Lawrence L. Garner.

## 7

### CONJUNCTIVA, CORNEA, SCLERA

Appelmans, M., and Michiels, J. **Keratoconjunctivitis aphtosa.** Bull. Soc. belge d'opht. **110**:294-298, June, 1955.

For the last six months the child observed by the authors had recurrent aphthous stomatitis which interfered considerably with the nursing. Both eyes showed superficial corneal lesions and a membranous conjunctivitis of the lower lid. While the viral etiology of Behçet's disease had been confirmed, the viral etiology of aphthous stomatitis and the rare simultaneous conjunctivitis and keratitis has not been established. However, more cases were seen during the last years than in previous years. The keratitis did not improve with aureomycin therapy given locally or systemically. Cauterization with iodine gave better results. Solutions of aluminum sulfate, used locally, seemed to promote recovery. Its mode of action is still unknown. (8 references)

Alice R. Deutsch.

Appelmans, M., and Zwijsen, J. **Conjunctivitis in association with concretions in the lacrimal passages.** Bull. Soc. belge d'opht. **110**:267-273, June, 1955.

The Actinomyces bovis is a facultative parasite. It may invade the conjunctiva and the canaliculi as an ectoparasite and because of the formation of concretions produce swelling and inflammation. The subsequent stasis in the lacrimal sac favors secondary bacterial invasion. It is this bacterial invasion which mostly dominates the clinical picture and causes either a mucopurulent, purulent or pseudotrachomatous conjunctivitis and dacryocystitis with or without corneal injury. This kind of conjunctivitis resists treatment by sulfonamides or antibiotics but is cured as soon as the lacrimal deposits are removed. If the actinomyces passes the epithelial barrier, a severe follicular conjunctivitis with adenopathy occurs, resembling Parinaud's oculoglandular syndrome or the nodular conjunctivitis, ascribed by Verhoeff to a Leptothrix infection. The authors, quoting the opinion of mycologists, do not recognize the Streptothrix foersteri as a specific variety of fungus but believe that actinomyces and Aspergillus niger are the local offenders in this type of conjuncti-

vitis. In deep inflammatory and pseudotumoral lesions of this group a diagnosis is only possible by biopsy and pathologic examinations.

The three patients treated by the authors had a severe monocular conjunctivitis, refractory to the usual treatment. The tear sacs could be irrigated under pressure. After expression of the lacrimal concretions the conjunctivitis subsided. The cultures showed growth of Actinomyces bovis and Aspergillus niger. (4 figures, 22 references)

Alice R. Deutsch.

Gundersen, Trygve. **Cornea and sclera.** A.M.A. Arch. Ophth. **55**:274-292, Feb., 1956.

This excellent annual review of the literature for 1954 on the cornea and sclera is well worth reading in full. (252 references) G. S. Tyner.

Heydenreich, A. **Hemorrhagic lymphangiectasia of the conjunctiva.** Klin. Monatsbl. f. Augenh. **128**:83-85, 1956.

After repeated and prolonged conjunctival hemorrhage the lymph vessels of the conjunctiva may become dilated and function poorly. They may remain blood-filled for a long time (as in this 50-year-old man). A characteristic of the lymph vessels is the segmented and ampulliform pattern of the blood that fills them and also their situation in a deeper conjunctival stratum than that which is occupied by the blood vessels. (2 figures, 14 references) Frederick C. Blodi.

Hilton Rocha. **Corneoscleral transplant in epibulbar epithelioma.** Rev. brasil. oftal. **14**:397-403, Dec., 1955.

The author presents a case of very extensive epibulbar epithelioma, in which corneoscleral transplantation was done. The area of cornea to be excised was outlined with a 10 mm. trephine and the portion of sclera was cut freely with a scissors. Several millimeters of macroscopically uninvaded tissue was removed on both the corneal and the scleral side. After exposing the iris and ciliary body in this area, an exactly similar portion of cornea and sclera was excised from the donor eye and placed in the recipient eye, where it was sutured with numerous interrupted sutures. The patient developed secondary glaucoma for which a cyclodialisis was done after two months. After four months the patient had a linear leucoma in the area of the transplant and was able to count fingers at two meters without correction.

The author had expected a postoperative atrophy of the globe due to probable injury to the ciliary body and the fact that it did not occur makes him optimistic about the future of so drastic an operation. (3 figures, 12 references)

Walter Mayer.

Jaeger, Wolfgang. **Corneal damage by vapor of butyl alcohol.** Arch. f. Ophth. **156**:480-483, 1955.

The patients presented themselves because of a burning sensation in the eye, photophobia and epiphora. There were no hyperemia or corneal changes visible with a magnification of 10 diameters in direct illumination with the slitlamp, and fluorescein produced no visible staining. When the cornea was inspected with a magnification of 25 to 40 diameters in retroillumination from the iris, innumerable smallest vacuoles were seen in the deeper strata of the corneal epithelium in its central portion. (1 figure)

F. H. Haessler.

Kogan-Abezgus, P. **The cultivation of virus and serologic diagnosis of trachoma.** Vestnik oftal. **34**:7-11, March-April, 1955.

A review of the literature shows that there is as yet no specific laboratory diagnosis of trachoma. The author cultivated

the trachoma virus on chick embryo and used the antigens. The scrapings from the conjunctiva and matter from expressed follicles from fresh cases of trachoma served as material for the infection of the embryo. Trachoma patients with Prowazek's inclusion bodies were used. This material was introduced into the allantoid space and into the yolk sac of seven-day-old chick embryos. The eggs were incubated from three to nine days, then the allantoid fluid from the yolk sac was obtained. This material was introduced into fresh embryos, repeatedly from 6 to 16 times. The allantoid fluid in the tissue of the yolk sac was examined for the content of the specific antigens with the blood serum of the trachomatous patients.

The author established that it is possible to cultivate the trachoma virus in a number of repeated passages in developing chick embryos, under the control of the reaction of complement fixation. The intensity of the reaction of the complement fixation was higher when using the yolk antigen than when using allantoid fluid. Regular positive results were obtained of the complement fixation reaction with the blood serum from patients with advanced and complicated trachoma. The blood serum of patients in the early stage of trachoma and normal subjects usually gave a negative result. Olga Sitchevska.

Merté, Hanns-Jürgen. **A contribution to the treatment of vernal catarrh.** Klin. Monatsbl. f. Augenh. **128**:30-34, 1956.

Antihistamines and cortisone may depress the local symptoms but cannot prevent another attack. For that purpose a polyvalent mixture of antigens of staphylococcus, streptococcus, pneumococcus and tubercle bacillus was used for desensitization. Out of six children treated, four remained without recurrence for three years. A prophylactic treatment during the winter months is advocated. (4 figures)

Frederick C. Blodi.

Ostriker, P. J., Ostriker, M., and Lasky, M. A. **Keratitis and scleritis associated with Felty's syndrome.** A.M.A. Arch. Ophth. **54**:858-862, Dec., 1955.

A case report and discussion of a scleritis associated with Felty's syndrome are presented. It is believed that this report is the first in the literature that shows this association. Felty's syndrome consists essentially of chronic rheumatoid arthritis, splenomegaly, and leucopenia. (1 figure, 14 references)

G. S. Tyner.

Pavkovic-Bugarski, G., and Cvetojevic, M. **The influence of aureomycin on trachoma with biomicroscopic, microbiologic and histopathologic control.** Klin. Monatsbl. f. Augenh. **128**:16-30, 1956.

The authors are convinced that aureomycin has a good influence on trachoma. The influence is greater when the infection is recent and when sulfonamides are given orally at the same time.

Among 90 young patients, 79 received aureomycin ointment six times a day for 2-4 months. The other 11 patients were in addition put on oral sulfonamides. Out of 20 patients with trachoma I, 19 were cured, whereas out of 44 with trachoma II only 28 were cured. The cure rate was still lower (11 out of 26) in trachoma III. All the patients were controlled by repeated bacteriologic, biomicroscopic and occasional histologic examination. (6 figures, 36 references)

Frederick C. Blodi.

Petrohelos, M. A., and Wolter, J. R. **Necroscleritis nodosa.** A.M.A. Arch. Ophth. **55**:221-228, Feb., 1956.

The pathologic characteristics of necroscleritis nodosa are as yet not sufficiently

known to enable the ophthalmologist to differentiate certainly this disease from brawny scleritis or scleromalacia perforans and other similar entities. A case is reported in detail, clinically and pathologically, in a 72-year-old women whose eye did not respond to any medication. Enucleation became necessary. (10 figures, 20 references) G. S. Tyner.

Putchkowskaya, N. **Peripheral lamellar keratoplasty.** Vestnik oftal. **34**:11-16, May-June, 1955.

Putchkowskaya describes her modified lamellar keratoplasty. It consists of removing the opaque layers of the cornea until the transparent layers are reached. A transplant from the cadaver is cut in the shape of a ring and is applied only to the periphery of the cornea (hence the name, "peripheral"). It is sutured to the episclera at the limbus. The central position of the cornea remains uncovered. Epithelization of this part takes place from 24 to 48 hours from the adjacent uninjured cornea. The regeneration of the cornea occurs under the epithelium, so that in a few months the cornea becomes nearly normal in its curvature. Previous attempts to cover the central area of the cornea by the transplant led to scar formation between the transplant and the corneal tissue of the host.

Twenty severely injured eyes with thick leucomas due to burns with hot metal (13 eyes), with acids or alkali were operated on. In 16 eyes there was symblepharon on which a plastic operation was done preceding the keratoplasty. The postoperative inflammation was alleviated with tissue therapy. The period of observation was from a few to 45 months. The visual acuity improved from light perception to finger counting and in some to a little more. The optical result was much better with this peripheral lamellar operation than with the penetrating keratoplasty, as these nearly hopeless cases did not respond well to the latter operation. (4 figures, 1 table)

Olga Sitchevska.

Sage, H. M., Jr., and Suie, T. **Adenoidal-pharyngeal-conjunctival virus infection with associated corneal involvement.** A.M.A. Arch. Ophth. **55**:269-270, Feb., 1956.

This case is reported to put on record the corneal involvement in a case thought to be APC virus infection. (2 references)

G. S. Tyner.

Savin, L. H. **Corneal dystrophy associated with congenital ichthyosis and allergic manifestations in male members of a family.** Brit. J. Ophth. **40**:82-89, Feb., 1956.

The author describes a family in which some of the men have corneal dystrophy, ichthyosis simplex and allergic manifestations such as hay fever and asthma. The corneas contained numbers of small, highly refractile nodules in the epithelium, in the superficial layers of the stroma, and in the endothelium. Vision is not impaired to any degree but pain, photophobia and epiphora are prominent. The symptoms can be compared to those in recurrent epithelial erosions, but in this instance one can find no break in the epithelium. The use of a lubricant at bedtime was found to give comfort. (4 figures, 2 references)

Lawrence L. Garner.

Sivasubramaniam, P., and Hoole, T. **Unusual case of interstitial keratitis.** Brit. J. Ophth. **40**:119-122, Feb., 1956.

The authors describe a case of interstitial keratitis in a woman, 23 years of age, because of its close mimicry of Mooren's ulcer. Because of previous antisyphilitic therapy the patient was seronegative and no definite evidence that tuberculosis was the cause could be found. No therapy, including annular

keratoplasty, was effective. The authors also point out that this lesion was not certainly interstitial keratitis; it might have been atypical Mooren's ulcer. (3 figures, 4 references)

Lawrence L. Garner.

de Toledo, Celso. **Prognosis in rupture of Descemet's membrane.** Rev. brasil. oftal. **14**:435-437, Dec., 1955.

The author found a rupture of Descemet's membrane postoperatively in three patients. Observation for several years persuaded him that such ruptures do not reduce the visual acuity and have no prognostic significance. (1 figure, 3 references) Walter Mayer.

## 8

### UVEA, SYMPATHETIC DISEASE, AQUEOUS

Arkhangelsky, V. **The treatment of tumors of the iris with electrodiathermy coagulation.** Vestnik oftal. **34**:36-42, March-April, 1955.

Arkhangelsky describes in detail his method of treatment by electrodiathermy of pigmented and nonpigmented tumors of the iris. Most of the patients, 25 to 35 years of age, were observed for 12 years, and none had a recurrence. In nine patients there were pigmented melanomas; the others had angioma, hemangiendothelioma and endothelioma. The electrocoagulation does not cause necrosis of the tissue of the iris. The scar is fine and regeneration of the tissue is possible. The vision was conserved in most of the eyes. The author is convinced that eyes with malignant tumors should not be enucleated. He also prefers this treatment to iridectomy for removal of the tumor. (2 figures)

Olga Sitchevska.

Cameron, M. E., and Choyce, D. P. **Sympathetic ophthalmia.** Brit. J. Ophth. **40**:123-125, Feb., 1956.

The authors report the rare occurrence of subconjunctival dislocation of the lens with sympathetic ophthalmia in a man who was punched in the eye. The rapid response of the sympathized eye is ascribed to the therapeutic use of cortisone, since the enucleation of the exciting eye is thought to be of doubtful value. (3 figures) Lawrence L. Garner.

Capper, S. A., and Leopold, I. H. **Mechanism of serous choroidal detachment.** A.M.A. Arch. Ophth. **55**:101-113, Jan., 1956.

The present work was undertaken to study serous choroidal detachment as to its etiology and mechanism of production. These studies indicate that both surgical trauma and hypotony are necessary for the experimental production of serous choroidal detachment. Surgical trauma appears to have a localizing influence on the site in which the detachment will occur. (7 figures, 5 tables, 23 references) G. S. Tyner.

Drozdowska, S., and Slomska, J. **Uroprecipitating reactions in uveitis.** Postepy Okulistyki **1**:78-85, 1954.

The authors used the uroprecipitating test developed by one of them. It is based on the fact that in some conditions bacterial antigens appear in the urine and can be precipitated by the serum of the patient. This test was used in 35 patients with iritis, iridocyclitis and uveitis and 5 with scrofulous conditions of the eye, which served as controls. In no case was there evidence of focal infection or rheumatic disease. In 16 cases the uroprecipitating test was negative. Despite negative tests for tuberculosis, treatment with PAS, streptomycin and calcium was used in these patients, with good result. In 19 cases the uroprecipitating test was positive. The inflammation was apparently caused by focal infection.

Treatment with typhoid vaccine was very effective. (1 table, 8 references)

Sylvan Brandon.

Fischer, A., Freytag, B., and Remky, H. **Clinical, bacteriologic and serologic data in leptospiral uveitis.** Arch. f. Ophth. **156**:494-502, 1955.

Uveitis occurred one and one half years after a severe general infection with leptospira icterohemmorhagiae which occurred in a young man after he had injured his foot while swimming in a canal. During this episode of ocular inflammation there was a high agglutination titer in the aqueous and leptospira were cultured from the aqueous of each eye. By means of serologic reactions these leptospira were identified as L. saxkoebing, whereas the source of the general infection was L. icterohemmorhagiae. (1 figure, 2 tables, 21 references)

F. H. Haessler.

Fry, W. E., and Spaeth, E. B. **Subacute circumscribed macular retinochoroiditis simulating intraocular tumor.** Tr. Am. Acad. Ophth. **59**:346-355, May-June, 1955.

The authors report two cases of the abnormality described in the title and also the clinical and pathologic findings in a case of malignant melanoma. The end result in a case of localized retinochoroiditis is presented and the importance of early active treatment is emphasized. The differential diagnosis of elevated pigmented macular lesions is discussed. (8 figures)

Theodore M. Shapira.

Kapuscinski, W. J., Jethon, Z., Sikorska, K., Pacynska, J., and Ojrzynski, Z. **The aqueous in iritis after treatment with antistine and typhoid vaccine.** Postepy Okulistyki **1**:57-68, 1954.

The presence of histamine in the aqueous of patients with iritis or iridocyclitis was determined by noting the effect on the frog's heart. An increase of the concentration of histamine slows the heart beat or decreases its amplitude. Normal aqueous contains substances which inhibit the heart in ⅔ of the cases; the remaining ⅓ had stimulating substances. The addition of antistine to the aqueous did not influence its effect on the heart. Aqueous in ⅔ of 39 patients with iritis contained inhibiting substances. The others had no allergic component. Antistine, taken orally, blocks histamine bodies but has no influence on iritis. Typhoid vaccine inhibits histamine bodies and also influences inflammation beneficially. (7 figures, 2 tables, 20 references)

Sylvan Brandon.

Purik, P. **The treatment of glaucomatous iridocyclitis.** Vestnik oftal. **34**:13-17, Jan.-Feb., 1955.

From 1925 to date, a number of patients with glaucomatous iridocyclitis were treated successfully with mydriatics, chiefly with 0.25 percent scopolamine ointment, applied four to six times a day. The histories of a few patients illustrate the effectiveness of the treatment. Purik believes that scopolamine is more effective than atropin because it has a sedative influence and is used in smaller doses. Occasionally, there was a temporary increase of ocular tension after the use of scopolamine, which decreased when the drug was used more frequently. The time of treatment is much shortened compared with the treatment with pilocarpin. If the ocular tension is not decreased with scopolamine, surgery is done, after which scopolamine is again used.

Olga Sitchevska.

Remky, H. **Experiments on the effect of high doses of vitamin D on chronic uveitis.** Klin. Monatsbl. f. Augenh. **128**: 70-75, 1956.

High doses of vitamin $D_2$ increased the blood-aqueous barrier in rabbits which were first given pilocarpine to break down that barrier. This protective mechanism ceases after three weeks and cannot be obtained with vitamin $D_3$ or small doses of $D_2$. (4 figures, 5 references)

Frederick C. Blodi.

Sorsby, A., and Savory, M. **Choroidal sclerosis. A possible intermediate sex-linked form.** Brit. J. Ophth. **40**:90-95, Feb., 1956.

The authors describe marked, generalized choroidal sclerosis in one male member of each of two families in which the other members showed fundus findings difficult to interpret. In one family, one of the two other men showed extensive choroidal atrophy, and the other a retinitis pigmentosa reaction with a macular lesion and exposure of the choroidal vessels centrally. A daughter of one of these men showed an anomalous central fundus appearance suggestive of a carrier state. In the second family a daughter, a sister, and the young son of this sister all had fundus findings suggestive of choroideremia. The authors suggest that the affection may be inherited in an irregularly dominant manner as well as in the established dominant mode of inheritance. If the second family is regarded as one with choroideremia, well marked choroidal sclerosis must be accepted as an intermediate stage of the affection. (8 figures, 2 charts, 1 reference)

Lawrence L. Garner.

Witmer, R. H. **The etiologic diagnosis of uveitis.** Arch. f. Ophth. **156**:235-260, 337-373, and 356-373, 1955.

A survey of the literature convinces one that an etiologic diagnosis of uveitis does not exist. Unlike those who accept the modern concept of complex nervous and hormonal factors suggested by Speransky and Ricker, Witmer believes that uveitis is the result of an antigen-antibody reaction. His extensive studies of horses with leptospiral uveitis and rabbits with ocular tuberculosis demonstrated the formation of antibodies in eyes that have local infections. The antibody titer may be absolutely higher in the aqueous than in the serum. If there is an extraocular focus as well as intraocular inflammation then the antibody titer is only relatively higher in the aqueous than in the serum, that is, it is greater than it should be relative to the γ-globulin content which is manifested by electrophoresis.

These findings are also applicable to man although the relationships are less clear. In some cases of chronic granulomatous uveitis a high hemagglutination titer can be demonstrated which justifies an unequivocal diagnosis of tuberculosis, but on the other hand it is also clear that a high percentage of chronic granulomatous uveitis is not tuberculous in origin. In the latter it is shown that focal infection is an important cause and the methods for identifying the antigen are described. The possibility of specific therapy is discussed.

Incidentally, it was also shown that the percentile distribution of the various protein fractions in the aqueous of an inflamed eye of man, horse and rabbit, depends predominantly on the porosity of the blood-aqueous barrier. In a severe inflammatory lesion the electropherogram of the aqueous is essentially like that of the serum and in a vascular disturbance the small albumin molecules predominate over the larger globulin molecules. (14 figures, 25 tables, 97 references)

F. H. Haessler.

## 9

## GLAUCOMA AND OCULAR TENSION

Agarwal, L. P., and Saxena, R. P. **Role of diamox in glaucoma.** Ophthalmologica **130**:164-170, Sept., 1955.

Diamox in the usual oral dosage caused measurable lowering of the ocular tension in 9 out of 14 normal controls and in 12 out of 16 cases of chronic simple glaucoma. No significant change in facility of outflow accompanied the drop in tension. Diamox is most valuable prior to antiglaucomatous operations. (1 table, 19 references) Peter C. Kronfeld.

Arkin, W. **Reasons for cataract after antiglaucoma operations.** Postepy Okulistyki **1**:115-120, 1954.

Opacities that appear immediately after the operation are usually due to direct injury to the lens capsule during the surgical procedure. More important, however, are opacities that appear later, which happens frequently, particularly after filtrating operations. The author feels that, because of the surgery, the normal process of oxygen exchange is affected. He discusses the role of ascorbic acid in transportation of oxygen through the blood-aqueous barrier and through the lens capsule. It was noticed that in people with cataract, concentration of ascorbic acid in the aqueous is lowered or zero. After surgery the level of ascorbic acid is also lowered because of damage to the one-way barrier for reduced ascorbic acid. The author operated on rabbits, measuring ascorbic acid levels soon after the operation and a few weeks later. The second eye served as control. Soon after surgery ascorbic acid levels were significantly lower in the operated eye than in the control eye. (7 references) Sylvan Brandon.

Bennett, George. **Mortality rates in glaucomatous subjects.** A.M.A. Arch. Ophth. **54**:637-640, Nov., 1955.

The mortality rate of patients with primary glaucoma is no different than that of the general population. (9 tables, 4 references) G. S. Tyner.

Cramer, F. K., Iribarren, R., Sampaolesi, R., Lamela, N., and Oblati, E. **Priscoline test in diagnosis of early glaucoma.** Arch. oftal. Buenos Aires **30**:347-349, Sept., 1955.

When used in the form of a 1 cc. subconjunctival injection of the 1-percent aqueous solution, priscoline (a proprietary name for 2-benzyl-4, 5-imidazoline hydrochloride) produces a rise of over 9 mm. Hg in the intraocular pressure of preglaucomatous or glaucomatous eyes, which may reach rather dangerous levels and lasts for a few hours. In normal eyes, the pressure rise is only very slight or absent.

This study was conducted on more than 120 normal, suspected abnormal, and confirmed glaucomatous patients of undetermined type, some of which had been previously submitted to a fistulizing operation. Precise statistical data on the results obtained are not given.

As, in addition to its vascular effect, the drug produces a wide mydriasis, the mechanism of the pressure changes is not easily understood. One could guess, however, that an increased filtering pressure-head and an iris blockade of the angle might be held responsible for the tensional peak in the simple and closed-angle type cases, respectively.

A. Urrets-Zavalía, Jr.

Duke-Elder, S., Kronfeld, P. C., and Chandler, P. A. **Symposium: Glaucoma.** Ophth. ibero am. **27**:93-130, 1955.

Sir Stewart discusses the physiology of ocular tension: two elements are responsible for ocular tension, the equilibrium pressure and the volume pressure. The equilibrium pressure depends upon a normal capillary permeability combined with a balance of osmotic forces. Volume increase is important since the sclera is only slightly elastic. The formation of aqueous is the result of controlled diffusion across the blood-aqueous barrier,

combined with a secretory mechanism in the ciliary body capable of creating a hypertonic aqueous solution. This, combined with an outflow mechanism at the chamber angle, brings about a circulation. Analysis of aqueous in primary glaucoma has shown that as far as osmotic pressure is concerned, abnormalities of secretion are not a factor. It is changes in the area of outflow that are responsible for the findings in primary glaucoma. Sclerosis in the chamber angle is the chief offending cause, but other factors must exist, since in early glaucoma the diurnal curve shows great variations; the pressure may be elevated one hour and normal two hours later. This could not exist in the face of organic sclerosis. The author feels that the vascular anomaly is the early feature of primary glaucoma, and that organic blockage results if the former is maintained for any length of time.

Kronfeld discusses the criteria of successful treatment in glaucoma. He suggests careful observation of the central fields in the open-angle or chronic primary glaucoma, and observation of the frequency of recurrence of attacks in the acute or shallow-angle glaucoma. Three complicating conditions must be distinguished from glaucoma: 1. senile macular degenerative changes, 2. obstruction of branches of the central retinal vein, and 3. opacities in the lens. Opacities of the nuclear type tend to definitely shrink the field isopters while glaucomatous scotomata will expand. In themselves, the nuclear opacities do not produce glaucomatous fields. Tension which is consistently above 27 will, in the majority of instances, result in field changes. The value of tensions taken at various hours of the day is stressed. The course of the optic nerve disease under conservative treatment serves as the best guide in the management of the condition. Tension-normalizing surgery, if done early, offers the best opportunity for maintaining the visual status and when the patient is seen in a late stage it still offers the best chance for normalization in those cases that are progressive under conservative therapy.

Chandler discusses the surgical treatment of acute glaucoma. He points out the importance of a correct diagnosis since the type of procedure indicated differs in the various types of glaucoma. Gonioscopy is important in ascertaining the presence of anterior synechiae in the periphery. Iridectomy or iridotomy is effective when done in shallow-angle glaucoma which can be controlled with miotics in the acute stage, if done within 24 to 36 hours after onset of symptoms. The procedure is equally effective in cases with a long history of repeated exacerbations, provided that the tension could be normalized with miotics in each instance. Patients over 60 years of age whose tension can be made normal with miotics should not be operated upon unless repeated attacks occur. In patients with acute glaucoma of two to three days duration the author definitely advises against the trephine operation. Iridencleisis is advised and the author describes a modified basal iridectomy which he finds very successful in most cases of this kind. This is particularly useful in the neglected patient who shows no response to conservative therapy.

Lawrence L. Garner.

François, J., and Neetens, A. **Ocular hypertension and herpes zoster ophthalmicus.** Bull. Soc. belge d'opht. **110**:115-126, June, 1955.

The ocular tension in cases of iridocyclitis in herpes zoster is almost always either normal or mildly decreased; however, cases of hypertensive anterior uveitis have been observed now and then. Very rarely ocular hypertension occurred before signs and symptoms of an irido-

cyclitis were manifest. The pathogenesis of this latter type of glaucoma was studied. The authors convinced themselves that two patients under their observation did not have an acute congestive glaucoma in spite of the clinical resemblance but a secondary glaucoma and iridocyclitis. The chamber angle was open and the tension had dropped after instillation of 2-percent adrenalin solution. It was the authors' opinion that the increase in ocular tension was not only caused by an overproduction of aqueous, but especially by an increased resistance to the outflow of aqueous. The increased resistance to the outflow was the result of an inflammatory swelling of the ciliary body, increased filling of the posterior chamber and consequently decreased depth of the anterior chamber. Tonography and registration of the depth of the anterior chamber were considered to be important diagnostic procedures. (3 figures, 58 references)

Alice R. Deutsch.

Gipner, J. F., Grant, W. M., Posner, A., Kennedy, R. E., Atkinson, W. S., Joy, H. H., Knighton, W. S., and Koenig, I. J. **Symposium: Management of glaucoma in the adult.** N. Y. St. J. Med. **56**:193-229, Jan. 15, 1956.

Grant, in discussing tonography in chronic glaucoma stresses the value of this procedure as an investigative and research modality, but states that in clinical practice ordinary tonometry is of equal value, and greater practicality.

Posner discusses acute narrow angle glaucoma, and its now classical treatment of peripheral iridectomy. He also describes in detail his technique for peripheral iridencleisis. Then he goes on to describe the thirteen salient features of glaucomatocyclitic crises, and their management. (2 figures, 5 references)

Kennedy covers the medical treatment of chronic glaucoma. He reviews the methods of diagnosis, and discusses the handling of the patient as a whole, the classical and newer miotics, and acetazolamide. (6 references)

Atkinson presents the field of anesthesia in glaucoma surgery, covering preoperative preparation, methods and details of local anesthesia, and various forms of general anesthesia. (9 figures, 3 references)

Joy discusses the surgery of chronic glaucoma. His operation of choice for general purposes is the iridencleisis, although he covers the details of most other procedures. (12 references)

Knighton in speaking on cyclodiathermy and cycloelectrolysis, expresses considerable disappointment in the results of these very popular procedures. Berliner, in discussing his paper, on the other hand, is very enthusiastic about cyclodiathermy. (11 references)

Koenig discusses secondary glaucoma, particularly that following cataract surgery. After listing the various causes, he discusses the treatment of uveitis associated with secondary glaucoma, and finally the surgical relief of the latter condition once it has supervened. (9 references)

Harry Horwich.

Haas, Joseph S. **Glaucoma.** A.M.A. Arch. Ophth. **54**:941-956, Dec., 1955. The pertinent literature for 1954-55 is reviewed. (194 references)

G. S. Tyner.

Kleinert, Heinz. **The action of adrenalin and other drugs upon the ocular tension.** Arch. f. Ophth. **157**:24-39, 1955.

The author administered as eye drops adrenaline, effortil and privine to a large number of normal and glaucomatous persons and summarizes his observations as follows. The outflow of aqueous humor increased for about 20 to 30 minutes. The bloodflow in the lamellated aqueous veins diminished. The ocular tension decreased by several mm. Hg Schiøtz, and the re-

sistance to outflow seemed to be diminished. (4 figures, 30 references)

Ernst Schmerl.

Laval, Joseph. **The use of absorbable gelatin film (gelfilm) in glaucoma filtration surgery.** A.M.A. Arch. Ophth. **54**: 677-682, Nov., 1955.

The author reports the successful employment of this material on animals and humans. No untoward effects were noted. The film becomes absorbed slowly and leaves a larger than usual filtering scar. A 4 × 10 mm. piece is placed between the incarcerated iris and Tenon's capsule. (9 figures, 5 references) G. S. Tyner.

Lytton, H. **Compression of the aqueous outlets.** Brit. J. Ophth. **40**:104-107, Feb., 1956.

The author uses an instrument with a conical ring to apply pressure at the limbus in order to inhibit the outflow of aqueous. In almost all of his patients this procedure produced no significant change in the tension. Since he has obstructed the major outlet it must be assumed that aqueous production is inhibited by the pressure as applied externally and he questions the accuracy of tonography which does not take this inhibition into account. He suggests that the production of aqueous is automatically regulated by the intraocular pressure. (2 figures, 1 table) Lawrence L. Garner.

Rintelen, F., and Jenny, E. **Diamox therapy in glaucoma.** Ophthalmologica **130**:171-177, Sept., 1955.

On the basis of a series of 30 cases the authors recommend diamox for the treatment of glaucoma secondary to uveitis and of acute narrow-angle glaucoma. The drug also serves the purpose of temporary lowering of tension prior to globe-opening operations, during the first few days after cyclodiathermy and just before diagnostic dilation of the pupil in patients with narrow-angle glaucoma. (3 tables, 9 references) Peter C. Kronfeld.

Schaffer, R. N., Scheie, H. G., Barkan, O., Haas, J. S., and Meyer, S. J. **Glaucoma—Symposium.** Tr. Am. Acad. Ophth. **59**:297-345, May-June, 1955.

**Pathogenesis of congenital glaucoma: Gonioscopy and microscopic anatomy.** pp. 297-308.

**Diagnosis, clinical course, and treatment other than goniotomy.** pp. 309-321.

**Goniotomy.** pp. 322-332.

**End results of treatment.** pp. 333-341.

**Review, summary, and conclusions.** pp. 342-345.

The term congenital glaucoma is applied to those cases of ocular hypertension in which the decreased aqueous outflow can be ascribed to defective embryonal development. The various types of juvenile glaucoma are described. Histologic study shows no abnormal mesodermal reticulum in infantile glaucoma. The insertion of the iris is high on the trabecula and Schlemm's canal is not perfectly formed. It has been gonioscopically demonstrated that Schlemm's canal can be filled with blood in most eyes with infantile glaucoma. The insertion of the iris is into the trabecula.

Early diagnosis is of utmost importance. Photophobia in a child less than one year of age should suggest the possible diagnosis of infantile glaucoma. A trial of medical therapy wastes time; goniotomy or goniopuncture, or the two combined, is the surgical method of choice. The operation is described and it is shown that it restores the physiologic direction of outflow without creating a pathologic condition. The results are superior to those of classical filtering operations. The prognosis is poorer in infantile glaucoma, which is present at birth or in the first

two months, than in that which begins later. (27 figures, 8 tables, 118 references)

Theodore M. Shapira.

Tamler, E., and Maumenee, A. E. **Lens extraction in the treatment of glaucoma.** A.M.A. Arch. Ophth. **54**:816-830, Dec., 1955.

The authors review the indications for lens extraction in various types of glaucoma secondary to lens change. They introduce an indication for lens extraction which, although not new to the minds of ophthalmologists, is not widely discussed in current literature. Extraction appears indicated in intumescence, phacolytic glaucoma, glaucoma secondary to a dislocated lens, and malignant glaucoma, but its value is doubtful in glaucoma capsulare. In addition, lens extraction is suggested in advanced cases of acute iris-block glaucoma with a very shallow anterior chamber and high tension which does not respond to medication, or in cases in which the patient has been in the acute attack for three days or more. This suggestion is made even when the lens is clear, but especially when the lens is already moderately to densely opaque or when the other eye is already aphakic. (1 table, 54 references)

G. S. Tyner.

Unger, Hanns-Hellmuth. **Gonioscopic findings after Elliot trephining.** Arch. f. Ophth. **156**:484-493, 1955.

Postoperative gonioscopic inspection of 100 eyes revealed inclusion of iris or lens tissue in the trephine opening in very many of them. There was no relationship between the inclusion of tissue and the effectiveness of the surgery. All eyes in which the tension had been reduced had a definitely active fistula and in some eyes in which the fistula was scarred, the tension could be kept normal with miotics. In chronic congestive glaucoma the effectiveness of trephining was ascribed to the iridectomy. Despite newer theories, the author ascribes the effectiveness of the Elliot operation to filtration rather than to a predominantly neurovascular action. (3 figures, 3 tables, 53 references)

F. H. Haessler.

Weekers, R., Watillon, M., de Rudder, M., and Gustin, J. **Standards for determination of ocular tension. (The new tables of the American committee on standardization of tonometers, 1954.)** Bull. Soc. belge d'opht. **110**:111-114, June, 1955.

The importance of a standardization of the tonometers and of the creation of a station for inspection of tonometers similar to those in the U.S.A. was recognized. Attention was called to the lower average values (3 mm.) of the new tonometer curves as compared to the Schiøtz curves of 1948. (3 tables)

Alice R. Deutsch.

Weinstein, P., and Forgacs, J. **Data concerning the tension-lowering effect of diamox.** Ophthalmologica **130**:159-164, Sept., 1955.

The tension-lowering effect of diamox may, a priori, be ascribed to one of three mechanisms: improved aqueous outflow, reduced aqueous secretion, or increased reabsorption of aqueous into the ciliary plexus. The authors found that diamox administered by mouth caused a reduction of the sodium and $CO_2$ content as well as of the pH of the aqueous in four dogs. In man, the reduction of the ocular tension by diamox was not associated with a change in the permeability of the blood-aqueous barrier. In one case of absolute glaucoma diamox failed to lower the ocular tension while topically applied adrenalin succeeded. The authors conclude that diamox probably reduces the rate of aqueous secretion and also improves the reabsorption of aqueous into

the ciliary plexus. (4 figures, 18 references) Peter C. Kronfeld.

## 10

### CRYSTALLINE LENS

Corin, Norman. **Spontaneous complete absorption of a cataractous lens.** A.M.A. Arch. Ophth. **55**:118, Jan., 1956.

A case is reported of a complete absorption of a cataractous lens 29 years after development of a toxic cataract, with 20/20 corrected vision. (5 references) G. S. Tyner.

François, J., and Beheyt, J. **X-ray cataract and cystamine.** Bull. Soc. belge d'opht. **110**:150-157, June, 1955.

Cystamine (β-mercaptoethylamide = $HS\text{-}CH_2\text{-}CH_2NH_2$), a dacarboxylation product of cystein and its oxide cystamine, proved to be a very effective protective substance if given before irradiation. X-rays act on the metabolism of the cells by ionizing the water molecules and liberating H, OH and $HO_2$ which have oxydizing action in the presence of oxygen. Cystamine apparently competes with the liberated radicals, especially with $HO_2$. It acts at the level of the cell. It only protects if it is in the tissue when the irradiation takes place. Even if it is administered immediately after the irradiation, it is not effective. Its action is of short duration when given intravenously as it is rapidly metabolized.

The authors used rabbits for their experiments. The techniques were as follows: 200 k.v. 20 mA, filtration ½ mm.Cu and 1 mm. Al. focal distance 30cm., surface 2 cm. The animals were divided into three groups. Group 1 received cystamine intravenously, group 2 received the cystamine by instillation into the eye and intravenously, Group 3 received the drug by instillation only. The results are presented in tables. The tables indicated that cystamine retarded but did not prevent cataract formation, that it averted radium dermatitis and conjunctivitis when given intravenously, and that it had no protective action whatever in local instillation. (2 tables, 9 references) Alice R. Deutsch.

Kirsch, R. E., and Steinman, W. **Digital pressure, an important safeguard in cataract surgery.** A.M.A. Arch. Ophth. **54**:696-703, Nov., 1955.

The authors advocate the use of digital pressure after the introduction of retrobulbar anesthesia before cataract surgery. Their studies indicate that a profound hypotony results from this manipulation. The hypotony is a safeguard against vitreous loss and expulsive choroidal hemorrhage. In 100 cases in which digital pressure was maintained for five minutes there was no vitreous loss. (6 tables, 10 references) G. S. Tyner.

Parker, Charles O., Jr. **Spear cataract.** A.M.A. Arch. Ophth. **55**:23-24, Jan., 1956.

After a brief review of the four cases previously reported, Parker adds a case in a 22-year-old white male. The lens contained many yellowish-white, needle-like crystals, some of which were iridescent, extending in random directions, singly and in groups throughout the lens with no relation to anatomic structure. The corrected vision was 20/25. In one reported case, the lens was extracted and the crystals were found to be calcium sulfate. (2 figures, 6 references) G. S. Tyner.

## 11

### RETINA AND VITREOUS

Adams, Samuel T. **Retinal breaks in eye bank eyes.** A.M.A. Arch. Ophth. **55**: 254-260, Feb., 1956.

Eleven eyes from the eye bank were examined before fixation by indirect ophthalmoscopy by a new technique. Three

of these presumably normal eyes were shown to have two breaks each in the retina. Both round, operculated holes and horseshoe tears were found and thought to have a similar mechanism of formation. (15 figures, 5 references) G. S. Tyner.

Busch, K. T. **The light sense examination as a prognostic sign after a retinal detachment.** Klin. Monatsbl. f. Augenh. **128**:42-50, 1956.

Comberg's comparative test is used. A small light source is held at one meter and while the lids are closed the light sensation in one eye is compared with that of the fellow eye. This test was used on 141 patients after a retinal detachment operation. It was an excellent indicator as to the prognosis of visual recovery. It was more reliable than the early testing of visual acuity. (5 figures, 6 references) Frederick C. Blodi.

Dhanda, R. P. **Electroretinography in night blindness and other vitamin A deficiencies.** A.M.A. Arch. Ophth. **54**:841-849, Dec., 1955.

An eye with night blindness due to vitamin A deficiency gives a negative response in electroretinography. Children are more susceptible to vitamin A deficiency than adults, but respond more readily to treatment. (8 figures, 1 table, 4 references) G. S. Tyner.

Elwyn, Herman. **The changes in the fundus of the eye in arterial hypertension.** A.M.A. Arch. Ophth. **55**:3-8, Jan., 1956.

The fundus changes found in arterial hypertension are of two types: 1. those present in essential hypertension, which are due to aging and arteriosclerosis, and 2. those due to abnormal narrowing of the retinal arteries with secondary changes in the substance of the retina, and which is described as arteriospastic retinopathy.

In the first category are seen an irregular tortuosity of the retinal arteries, a widening of the light reflex, a hiding of a portion of the vein on each side of the crossing artery, irregularities in the course of the arteries and, when severe, a silver-wire appearance.

In arteriospastic retinopathy we see an abnormal narrowing of the retinal arteries, hyperemia of the optic disk, edema of the retina, hemorrhages, and cotton-wool patches. It is to be borne in mind that these vascular changes are present in other organs of the body. (3 references) G. S. Tyner.

Fischer, Franz. **Papilledema in diabetic retinopathy.** Arch. f. Ophth. **157**:201-206, 1955.

The author studied 300 cases of diabetic retinopathy. Papilledema occurred 17 times. In a few cases it was probably caused by cerebral processes. In the large majority of cases the papilledema and retinitis albuminurica was seen in patients with diabetic nephropathy. On the other hand, diabetic nephropathy and retinopathy without papilledema were seen quite frequently. (18 references)

Ernst Schmerl.

# NEWS ITEMS

Edited by Donald J. Lyle, M.D.
411 Oak Street, Cincinnati 19, Ohio

News items should reach the editor by the 12th of the month. For adequate publicity, notices of postgraduate courses and meetings should be received three months in advance.

## Deaths

Dr. R. Winfield Baeseman, Interlaken, New Jersey, died February 1, 1956, aged 59 years.

Dr. James Bordley, Jr., Baltimore, Maryland, died January 7, 1956, aged 81 years.

## Announcements

### Orthoptic examinations

The annual examination of orthoptic technicians by the American Orthoptic Council will be conducted in August and October, 1956.

The written examination will be nonassembled and will take place on Thursday, August 23, in certain designated cities and will be proctored by assigned ophthalmologists.

The oral and practical examinations will be held on Saturday, October 13, in Chicago just preceding the meeting of the American Academy of Ophthalmology and Otolaryngology.

Application for examination will be received by the office of the Chairman of Examinations:

Dr. Frank D. Costenbader
1605 22nd St., N.W.
Washington 8, D.C.

Applications, which must be accompanied by the examination fee of $30.00, will not be accepted after July 1, 1956.

### Histopathology of the eye

The State University of the New York College of Medicine at New York City announces a course in histopathology of the eye to be given by Dr. Gerald B. Kara, ophthalmic pathologist, June 4th to 9th. For details write to:

Mrs. Jackson
Department of Ophthalmology
451 Clarkson Avenue
Brooklyn 3, New York

### Symposium on ocular motility

A symposium on ocular motility will be conducted at the University of Colorado School of Medicine in Denver, July 23rd to 26th. The guest lecturers will be Dr. Francis Heed Adler, Philadelphia; Dr. Harold Whaley Brown, New York; Dr. Hermann M. Burian, Iowa City; and Dr. Arthur Jampolsky, San Francisco. The complete program and details may be obtained from:

The Office of Postgraduate Medical Education
University of Colorado School of Medicine
4200 East Ninth Avenue
Denver 20, Colorado

### Academy clinics in Mexico

Following the annual meeting of the American Academy of Ophthalmology and Otolaryngology in Chicago in October, a series of clinics will be conducted in Mexico City. Planes will leave Chicago on Saturday, October 20th, and return (Chicago and New York) Saturday, October 27th. The clinics will be informal and unrehearsed. Special cases will be presented by the staffs. Libraries and classrooms will be open and visitors will have the privilege of meeting and conversing with their colleagues in Latin America. The Mexican tour is sponsored by the Academy program committee and is an integral part of the 61st annual meeting. For travel details write:

Mr. Leon V. Arnold
33 Washington Square West
New York 11, New York

### Courses in basic ophthalmology

A comprehensive course in basic ophthalmology is offered by Wayne University Graduate College of Medicine in co-operation with the Kresge Eye Institute. Set up in its present form eight years ago under the direction of A. D. Ruedemann, M.D., the course has constantly been improved and expanded. This year a new auditorium and a teaching laboratory at the Kresge Eye Institute have greatly improved facilities for didactic training. The roomy, well-equipped eye clinic in the Farwell Annex of Receiving Hospital makes possible thorough clinical training.

Prerequisites for the course are an M.D. degree from an accredited medical college and one year of rotating internship. Classes are held full-time for nine months; six mornings a week are taken up by lectures, five afternoons by clinics. Subjects covered are anatomy, bacteriology, embryology, histology, pathology, ophthalmic biochemistry, ophthalmoscopy, physiologic optics, refraction, and ocular motility. Other related subjects are also briefly surveyed: such as, nutrition, endocrinology, and so forth. The principles of surgery are taught by lectures and laboratory work on animals' eyes. Tuition is $500.00.

Four fellowships at Detroit Receiving Hospital are available each year. Harper and Wayne County General hospitals send their residents in ophthalmology to Wayne University Graduate College of Medicine for this training during their first year of residency. Tuition for fellows and residents in affiliated-hospitals is only $108.00.

Openings are available for the academic year

1956-57. Classes begin on September 10, 1956.
Further information may be obtained from:

A. D. Ruedemann, M.D.
690 Mullett Street
Detroit 26, Michigan

### Special education in vision

Among the subjects to be studied at the first annual special education conference to be conducted June 21st and 22nd at the University of Missouri College of Education, Columbia, Missouri, is vision, which will deal with the problems of blind and partially seeing children. Further information may be obtained from:

Dr. Geraldine K. Fergen
College of Education
University of Missouri
Columbia, Missouri

### Slitlamp biomicroscopy and ocular surgery

The Committee on Postgraduate Education of the Montefiore Hospital announces an advanced course in slitlamp biomicroscopy of the living eye combined with additional courses in ocular gonioscopy, indirect ophthalmoscopy, surgery of intraocular foreign bodies, surgery of cataract, and glaucoma surgery, to be given by the Montefiore Department of Ophthalmology under the direction of Dr. Harvey E. Thorpe and associates. These courses will be given at the Montefiore Hospital, Pittsburgh, for five days, May 7th to 11th, from 8:30 A.M. to 4:00 P.M. Guest speakers will be Dr. Robert J. Masters, Indianapolis, and Mr. Lee Allen, Iowa City.

The fee for the course is $80.00. A deposit of $25.00 is required for registration.

For further information write to:

A. Lenas
Secretary of Postgraduate Ophthalmic Courses
323 Jenkens Building
Pittsburgh 22, Pennsylvania

## Miscellaneous

### Guild fellowship

The Guild of Prescription Opticians of America, Inc., has established 18 continuing fellowships for residents in ophthalmology. Each one of these fellowships will provide a total stipend of $1,800, payable in monthly installments over the three-year period of residency. These fellowships are being provided on a regional basis, with the United States and Canada divided into six geographic areas, each having approximately the same number of three-year ophthalmology residencies available. Selection of the recipient in each area will be made by a committee of ophthalmologists.

One fellowship in each of the six areas will be initiated this year, a second one next year, and a third one the third year, when there will be three fellowships in each of the six areas, for a total of 18. Thereafter, as each three-year residency is completed, a new fellowship will become available, constantly maintaining the number of fellowships at 18.

The obvious purpose of this program is to support ophthalmology by providing the additional sum which in many cases may be a determining factor in allowing the able young physician to continue in this specialty. It is sought, too, to provide this help on a nationwide scale through the geographic distribution of the fellowships.

The first fellowship in each of the six areas will be available on July 1st of this year. Detailed information of the requirements together with application blanks may be obtained by addressing the national headquarters:

Guild of Prescription Opticians of America, Inc.
110 East 23rd Street
New York 10, New York

### Trachoma research in middle east

A virus laboratory is being built in Jordan by the Order of the Hospital of St. John of Jerusalem for research on the virus of trachoma, which, it is estimated, affects a quarter of the world's population and causes more visual disability and blindness than any other disease. Sir Stewart Duke-Elder, the hospitaller of the Order, said that the laboratory would be under the direction of a research team consisting of a clinician, a virologist, and a bacteriologist.

Until recently, Sir Stewart said, trachoma was treated by cauterization by copper and other metals —the kind of treatment used 4,000 years ago. Antibiotics improved treatment by clearing secondary infection, but no drug is known to be specific against the trachoma virus, which has never been satisfactorily isolated, and which does not survive the journey to laboratories in other countries. The new laboratory will be the first built in a trachomatous area, and its position is medically ideal because most of the 400,000 refugees in Jordan have trachoma.

The Order of St. John has maintained a hospital in Jerusalem since the 7th century; the present hospital was attended by no less than 183,000 outpatients last year; but it is too small, and land has been bought and building plans are far advanced for a new 75-bed hospital, which will take part in the trachoma investigation.

The research will be sponsored and guided by the Medical Research Council, and the research team will work in association with the virus laboratories of the Lister Institute and the Institute of Ophthalmology in London. Financial support has been received from the British and Middle East governments, the World Health Organization, local oil companies, and the Wellcome trustees, and, with its own contribution of £290,000, the Order has sufficient funds to launch the research scheme and maintain it for seven years.

### Pathology course

The Armed Forces Institute of Pathology conducted its annual course in ophthalmic pathology during March. Included among the 49 ophthalmolo-

gists and pathologists taking the course were four physicians from Canada, Iran, Pakistan, and the Philippines; 22 from the Army, Navy, and Air Force; and six from the Public Health Service and Veterans Administration.

Dr. Lorenz E. Zimmerman, course director, announced that the tentative date for the 1957 course will be March 25th through March 29th, but that applications will not be accepted until November.

### Barcelona conferences

The Institute Barraquer, Barcelona, conducted a series of ophthalmologic conferences, April 10th to 22nd. Among the speakers were: Prof. Ignacio Barraquer, Dr. Joaquín Barraquer Moner, Dr. Juan Nieto, Dr. José María Cañadell, Dr. Alfredo Muiños Simón, Barcelona; Prof. Angel Moreu González-Pola, Santiago, Spain, Prof. José Casanova Carnicer and Dr. Pascual Gonzáles Marín, Barcelona; Dr. Olga Ferrer Paisán, Havana, Cuba; Prof. Buenaventura Carreras Matas, Granada, Spain; Dr. Jorge Malbrán, Buenos Aires, Argentina; Mr. B. W. Rycroft, Sussex, England; Dr. Antonio Clerici, Milan, Italy; Prof. Hans Goldmann, Berne, Switzerland; Dr. G. Meyer-Schwickerath, Bonn, Germany; Dr. Alfred Huber, Zurich, Switzerland; Dr. Jules Legrand, Nantes, France; Prof. Mario Maione, Genova, Italy; Dr. W. Leydhecker, Bonn, Germany; Prof. J. Charamis, Athens, Greece; Mr. C. D. Shapland, London, England; and Prof. Giambattista Bietti, Rome, Italy.

## Societies

### Oxford congress

The Oxford Ophthalmological Congress will convene at Balliol College, Broad Street, Oxford, on Sunday evening, July 1st, and meetings will be held on Monday, Tuesday, and Wednesday, July 2nd, 3rd, and 4th, in the lecture hall of the School of Physiology, South Park Road, Oxford. The Doyne Memorial Lecture will be delivered on Tuesday morning by Prof. Robert Platt, Manchester. Other speakers will be:

Mr. T. Keith Lyle, London; Mr. L. P. Jameson Evans, Birmingham; Mr. R. G. MacBeth, Oxford; Mr. P. McG. Moffatt, London; Mr. D. Stenhouse Stewart, Hull; Mr. F. W. Law, London; Dr. A. J. Bedell, Albany, New York; Mr. J. Minton, London; Mr. A. Pirie, Oxford; Dr. McLenachan, Birmingham; Mr. Rupert Parry, Cardiff; Dr. Jaeger, Heidelberg; Dr. J. Barraquer Moner, Barcelona; Mr. A. C. L. Houlton, Oxford; Mr. J. P. F. Lloyd and Mr. E. H. Leach, Oxford; Mr. F. A. Williamson-Noble, London; Mr. R. Pitts Crick, London; and Mr. D. Ainslie, London.

### Massachusetts Eye and Ear meeting

The annual meeting of the Massachusetts Eye and Ear Alumni Association was held in Boston on April 17th and 18th. Among the ophthalmic papers presented were:

"Experience with radioactive phosphorus as an aid in the diagnosis of ocular tumors," Joseph Dowling, Jr., Edwin B. Dunphy, and Alfred W. Scott; "Gonioscopy in uveitis," Robert J. Brockhurst; "Postenucleation invagination of the upper lid: Causes and treatment," William Stone, Jr.; "Spontaneous choroidal detachment," Ichiro D. Okamura; "Evaluation of cyclodiathermy as an antiglaucoma procedure," Robert R. Trotter; "Current status of tonometry," W. Morton Grant; "Single suture in cataract extraction," Garrett L. Sullivan.

"Glaucoma clinic: A four-year survey," Samuel T. Adams; "Time versus diabetic proliferating retinopathy," William P. Beetham; "Glaucoma after congenital cataract surgery," Paul A. Chandler; "Ocular cystinosis in the adults," David G. Cogan, Toichiro Kuwabara, Jin Kinoshita, Linus A. Sheehan, and Lorenzo O. Merola; "Seborrheic blepharitis: A new form of treatment," Gus C. Bahn; "Orbital lesions," Virgil G. Casten; "Exotropia surgery at the Massachusetts Eye and Ear Infirmary," David Johnson; "A new marking device and suture technique for corneal transplantation," William Stone, Jr.; "New methods in the clinical diagnosis and treatment of epithelization of the anterior chamber following cataract extraction," F. Phinizy Calhoun, Jr.

### Illinois convention

Among the speakers at the 26th convention of the Central Illinois Society of Ophthalmology and Otolaryngology held in Peoria, Illinois, April 13th to 15th, were:

"Congenital cataract," William Blender, Peoria; "Ocular injuries: Office and first-aid treatment," "Perforating wounds of the eyeball," and "Intraocular foreign bodies," I. S. Tassman, Philadelphia.

### United Kingdom meeting

Speakers at the annual congress of the Ophthalmological Society of the United Kingdom held in London, April 26th to 28th, were:

"The early diagnosis of glaucoma," Sir Stewart Duke-Elder, Mr. P. L. Blaxter, Mr. S. J. H. Miller, and Prof. G. P. Sourdille; "The relationship of hyaluronidase to aqueous outflow resistance," Dr. C. M. H. Pedler; "Rise of the ocular tension produced by circumscribed pressure on the sclera," Prof. B. Rosengren; "Secondary glaucoma," Mr. A. C. Higgitt; "Tonography in the diagnosis of closed-angle glaucoma," Mr. W. S. Foulds; "Choice of case for perforating keratoplasty," Mr. A. G. Leigh; "An assessment of modern views on the nature of endocrine exophthalmos," Mr. K. C. Wybar; "Infantile optic atrophy," Mr. J. H. Doggart; "The role of radioactive phosphorus in the diagnosis of ocular malignancy," Dr. Edwin B. Dunphy, Boston; "Migraine," Mr. Frank W. Law; "Emmetropia and its aberrations," Prof. Arnold Sorsby; "The diet of growing myopes: A preliminary examination of the problem," Mr. P. A. Gardiner; "An unusual congenital musculo-fascial anomaly and its surgical correction," Mr. T. Keith Lyle.

"Symposium: Herpetic infections of the outer

eye," Mr. A. J. B. Goldsmith, Dr. M. Lederman, Dr. J. A. Dudgeon; "A case of herpes zoster ophthalmicus associated with virus encephalitis and third-nerve palsy," Mr. J. Minton; "Diagnostic value of color fields in neurosurgery," Mr. George Alexander; "The present status of orbital implants and prostheses," Mr. J. R. Hudson; "Anticoagulant therapy in retinal vein thrombosis," Mr. R. W. Stephenson.

"Planned treatment of retinal detachments," Mr. L. G. Fison; "Paget's disease and the eye," Mr. E. G. Mackie; "Herbert's sclerotomy," Mr. Maurice Whiting; "Rheumatism and uveitis," Mr. A. Stanworth; "Reconstruction of the grossly contracted socket," Mr. J. C. Mustarde; "The problem of myelination in the central nervous system: With special reference to the optic nerve," Dr. B. A. Bembridge; "Maddox rod used as a retinal function test in cataract," Mr. John Primrose.

### Nassau meeting

At the April meeting of the Nassau (County, New York) Ophthalmological Society, Dr. John Harry King, Jr., of Washington, D.C., spoke on "Experience with newer corticosteroid hormones in the treatment of eye diseases."

### Brooklyn meeting

The 138th regular meeting of the Brooklyn Ophthalmological Society was held at the Brooklyn Eye and Ear Hospital. Dr. Frederick Sauter spoke on "Atypical Marfan's syndrome: O.S. subluxated lens extraction"; Dr. Samuel J. Blumenthal on "Posterior iritic adhesions"; Dr. Frank Paladino, "Angiomatosis retinae: Treated with diathermy coagulation"; Dr. Murray Silverstein, "Retinitis proliferans"; Dr. Joseph Mandelbaum, "Precipitation of acute glaucoma following use of 10-percent phenylephrine"; Dr. Milton Welt, "A case of lamellar keratoplasty."

### Pennsylvania convention

Dr. Albert C. Furstenberg, president of the American Academy of Ophthalmology and Otolaryngology, will be the guest of honor at the 13th annual convention of the Pennsylvania Academy of Ophthalmology and Otolaryngology, Bedford, Pennsylvania, May 24th to 26th.

### French program

On the program of the congress of the French Ophthalmological Society held in Paris May 6th to 10th were:

A. Zuccoli, Lugano, "Idiopathic cysts of the retina," discussion by A. Franceschetti; I. Stankovic, Belgrade, "The affections of the eye in pellagra," discussion by J. Sedan; Cl. Durix and M. Gallet, Casablanca, "Ocular lesions due to lacrimal gas," discussion by L. Paufique; A. Fritz, Brussels, "Action of Diamox on the circulation of the blood in the glaucomatous eye," discussion by P. Bailliart; A. G. Ourgaud, Marseille, "Description of a new procedure to determine visual acuity," discussion by M. Dubois-Poulsen.

G. P. von Berger, E. Fadiga, and G. C. Pupilli, Bologne, "Analysis of electric responses of the cerebellum to stimulation of the visual pathway in the cat," discussion by A. Franceschetti; W. J. Kapuscinski, L. Ogielski, and E. Ogielska, Wroclaw, "Experimental researches on the hyperergic and bacterial factor in iridocyclitis," discussion by F. Verrey.

A. M. Larmande, Algiers, "Radiographic aspects of certain rare neoplasms of the orbital vault," discussion by G. Offret; M. A. Dollfus, J. Legrand, and F. Baclesse, Paris, "Eosinophilic granuloma of the orbital walls," discussion by G. Offret; L. Paufique, R. Etienne, and Charleux, Lyon, "Pulsating exophthalmos due to orbital malformation in neurofibromatosis (Recklinghausen's disease)," discussion by G. Offret.

P. Desvignes and Dagorne, Paris, "Two cases of orbital cylindroma," discussion by G. Offret; O. Litricin and B. Jovicevic, Belgrade, "Eosinophilic pseudotumors of the orbit," discussion by J. Mawas; F. Hervouet, Nantes, and P. Tessier, Paris, "A new operative technique for ptosis," discussion by G. P. Sourdille; V. Valiere-Vialeix and A. Robin, Limoges, "Epidermoid epithelioma of the cornea and palpebral (superior) conjunctiva in a case of old pemphigus," discussion by G. Offret.

N. F. Ayberk, Istanbul, "Primary sarcomatous tumors of the four lids," discussion by M. A. Dollfus; Calmettes, Deodati, Planel, and Bec. Toulouse, "Influence of genital hormonal secretion on the lacrimal glands," discussion by M. Massin; B. Algan, and J. Cordier, Nancy, "The lacrimal localization of Besnier-Boeck-Schaumann disease," discussion by P. V. Morax.

Paul Bregeat opened the congress symposium on "Edema of the optic nerve." Other papers on this subject were presented by: Ch. Dejean, Montpellier, "Atypical edema of the optic nerve"; J. François, G. Verriest, and A. Barron, Ghent, "Vascular pseudopapillitis"; P. Danis and van Eyck, Brussels, "Intracranial hypertension and transitory external ophthalmoplegia after otitis"; J. and P. Wertheimer, Lyon, "The prognosis of choked disc in cerebral tumors"; R. Pigassou, Garripuy, and Lazorthes, Toulouse, "Statistics of the neurosurgical center of Toulouse: Cranial and fundus hypertension."

The symposium discussion was opened with presentation of films by A. M. Larmande, Algiers; Ch. Dejean, Montpellier; P. Tessier, Paris; G. P. Sourdille, Nantes; Otto Barkan, San Francisco; Mme. Delthil, Paris, and L. Coppez, Brussels.

Pierre François, M. Woillez, and R. Asseman, Lille, "Annular scotoma in certain blows on the optic nerve," discussion by M. Dubois-Poulsen; A. Torres-Estrada, Mexico, "Glaucomatous excavation of the disc," discussion by M. Redslob; E. B. Streiff and M. Deller, Lausanne, "Retrobulbar optic neuritis and Q fever," discussion by G. B. Bietti; M. Blagojevic and M. Arambasic, Belgrade, "The affections of the optic nerve in tuberculous meningitis," discussion by J. Lavat; H. Viallefont, Ch. Boudet, and M. Jaulmes, Mont-

pellier, "Optic nerve in leukoses," discussion by M. A. Dollfus; Ch. Thomas, Nancy, "The syndrome of amblyopia: The physiologic basis for therapeutic possibilities," discussion by Mme. Krajevitch; G. Sevrin, Charleroi, and G. Cuppers, Giessen, "The problem of fixation in amblyopia and partly in nystagmus," discussion by Ch. Thomas.

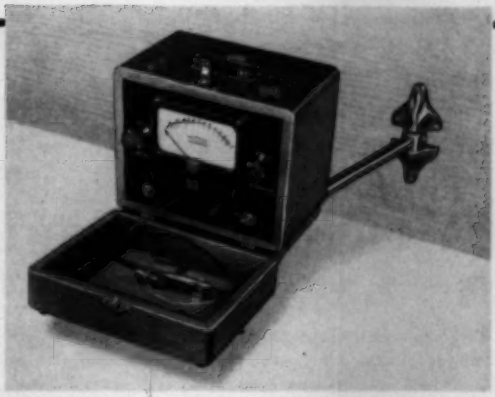
L. E. Grancini and G. Cenacchi, Varèse, "Some considerations on the electroencephalogram in some cases of amblyopia discovered in the schools," discussion by Mme. Delthil; J. Sedan, Marseille, "The utilization of the chromatic sense in severe amblyopia," discussion by P. Bailliart; A. de Jaeger and J. Bernolet, Bruges, "Amblyopia ex anopsia and our treatment by 'picage'," discussion by Mme. Braun-Vallon.

A. Favory and J. LaGraulet, Paris, "Optic atrophy and retinal lesions in ocular onchocercosis," discussion by M. Toulant; Vera Bischler and A. Franceschetti, Geneva, "Abnormal pigmentation of the pupil," discussion by J. Zanen; M. Appelmans and J. Michiels, Louvain, "Associated lesions of the retina and optic nerve in the newborn," discussion by Mme. Auvert; J. Zanen, A. Neunier, and P. Coppez, Brussels, "Achromatic and chromatic thresholds in central vision in certain diseases of the optic nerve," discussion by M. Dubois-Poulsen.

A. Dubois-Poulsen, Guillaume, and Cl. Magis, Paris, "Visual consequences of ligation of the anterior choroidal vessels," discussion by Mme. Schiff-Wertheimer; J. Charamis, Athens, "On the treatment of retinal detachment associated with inraocular foreign bodies," discussion by Mme. Schiff-Wertheimer; G. Georgiades, Salonica, "The syndrome of heterochromic cataract," discussion by M. Redslob; A. Bouzas, Athens, "Anterior chamber puncture and the study of the aqueous humor in diseases of the eyes in leprosy," discussion by F. Verrey; Necdet Sezer, Istanbul, "Preliminary report on the culture of trachoma virus," discussion by R. Nataf.

## Personals

Sir Stewart Duke-Elder gave the Thomas Young Lecture on April 12th, St. George's Hospital, London. He spoke on the "Eyes of invertebrates."



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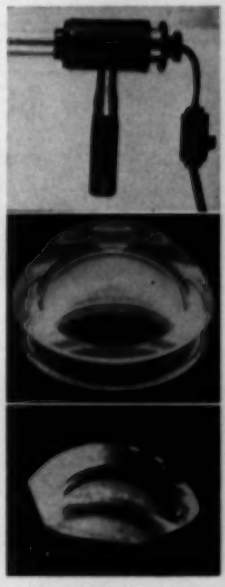

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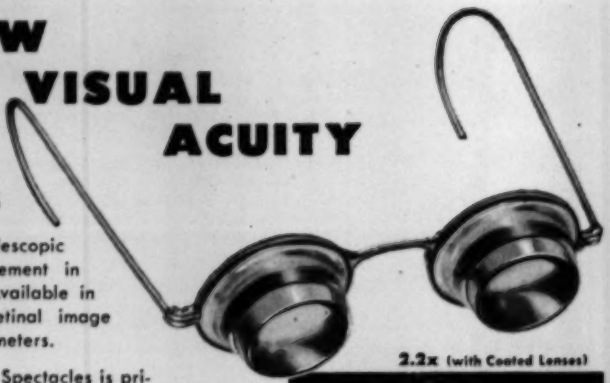

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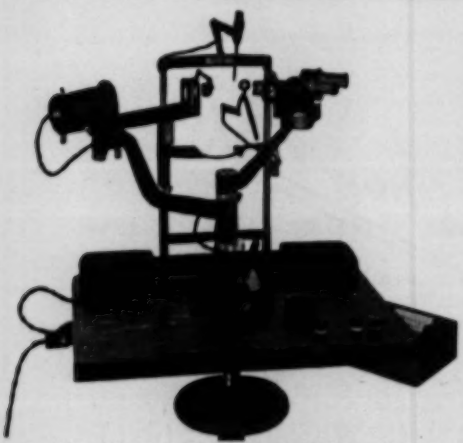

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*2 volumes of 6 numbers each are published annually. Subscription price U.S. $12.00 per volume (postage included).*

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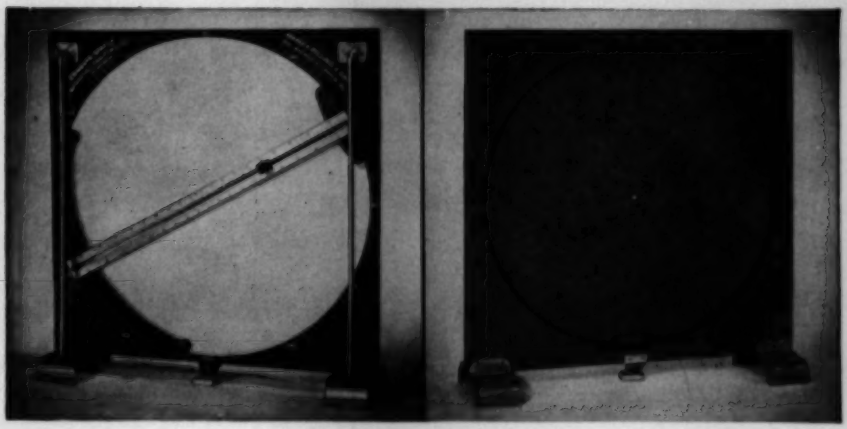

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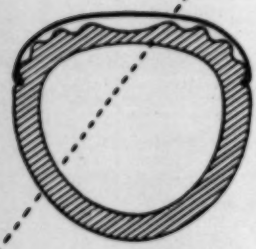

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